The Arithmetic Teacher

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An Ounce of Prevention
ESTHER J. SWENSON

The Elementary School Mathematics Library
RUTH HUTCHESON, EDNA MANTOR, AND MARJORIE HOLMBERG

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Report of the Nominating Committee

A Journal of
NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

THE ARITHMETIC TEACHER

a journal of
The National Council of Teachers of Mathematics

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THE ARITHMETIC TEACHER

Volume III Number 1

February 1956

An Ounce of Prevention

ESTHER J. SWENSON
University of Alabama

NO ONE WHO IS INTERESTED in our elementary schools could possibly have missed the continuing controversy as to whether or not Johnny can read and also why or why not. What has happened in the way of public criticism of the teaching of reading may also happen with respect to the teaching of arithmetic. In fact, we occasionally do have rumblings of discontent. During World War II we were told by some that the young men in the armed forces would have been more competent if they had only had more drill. Of course, if the public had only known it, they had probably had *too much* of the wrong kind of drill. Whether the end result of these public criticisms is favorable or unfavorable to the schools will depend in large part on how school people meet them.

How did the controversy over phonics in the reading program originate? Two contributing factors certainly were: (1) dissatisfaction felt by some parents and other members of the lay public and (2) lack of knowledge and understanding of the true school situation. The dissatisfaction with children's reading performance may lack direction. People do not know just what to be dissatisfied with. They feel something is wrong and would like to place responsibility somewhere. Then a critic comes along who exaggerates Johnny's plight and places the blame. Lack of phonics, he says! His oversimple diagnosis and cure are accepted by many people because they do not have enough background of information and understanding of the teaching of reading to "spot" the distortions of fact.

Implications for Teaching Arithmetic

All right, you say, people are vaguely dissatisfied with the educational product; a glib critic fans their dissatisfaction and points the finger of blame; they do not *know* the facts, so they accept his accusations as fact; and then we have trouble! What does *that* have to do with *arithmetic* and *arithmetic teaching?*

Widespread acceptance of modern teaching methods by our public schools came earlier in the field of reading than in the field of arithmetic. Such acceptance is not universal in reading, by any means; but it is safe to say that reading instruction is more generally adapted to what is known about child development and learning than is arithmetic instruction. For example, teachers in our elementary schools have either learned or are learning to adapt reading materials to children's abilities to handle them. Materials are suited to children's capability levels rather than having all children in a class forced to attempt the same reading tasks. That is far less common in arithmetic teaching,

for no apparent reason other than this: in arithmetic teaching, we just have not progressed as far in our applications of what we know about children's learning.

Actually, improvements in the teaching of reading during the past quarter century have been tremendous. That is as it should be. But too often the research workers in reading, the college professors who worked with teachers in training, and the teachers themselves were so engrossed in what they were learning and in ways to apply their learning that *they neglected to inform the general public* about instructional changes, the reasons for the changes, and the results of the changes.

Right now we are in a period of rapid progress in the teaching of arithmetic. One may venture to say that reading is generally better taught in American schools than is arithmetic, but we may well be on the threshold of similar tremendous advances along the line of emphasis upon meaning and understanding in arithmetic.

We who are interested in the teaching of arithmetic, we who are trying to help boys and girls understand what they do in arithmetic, we who are convinced that changes must be made in arithmetic instruction, *we all* had better give attention *now* to ways and means of *informing the interested public* of what these changes are and why we are making them! We should do this NOW—before some ill-informed critic has an inspiration to write a book called WHY ALICE CAN'T ADD.

We have noted the dangers in not informing the public about changes in teaching methods, but let us also pay our respects to some other basic reasons for doing so.

1. Most parents are very much interested in what concerns their children. They *want to know.*
2. Parents and the public in general have *a right to be told* what goes on in schools, and school people have a responsibility to keep the public informed.
3. If parents and teachers understand each other's objectives, they can better work together in promoting the welfare of the children with whose progress they are all concerned.

How Should We Inform the Public

Current attacks on elementary schools often focus on the learning of the skills. We hear much about the "good old days" and the "three R's." Have you noticed how often the attacks on modern education recommend a "return" to something "old" in the way of content or method? Have you stopped to analyze this tendency? Many people cling—or seem to cling—to the "old" and fear the "new." But perhaps the contrast between "old" and "new" ideas is not the basic one. Actually, many ideas considered as being "new" are very old. Rather, what the public refers to as "old" may be those with which they are familiar; folks feel comfortable in a familiar setting, whether it be a house or a set of ideas. The so-called "new" methods may be feared or rejected not really because they are "new" but because they are *strange, unfamiliar, unknown.*

We can afford to be optimistic about this situation. If it is the familiarity with the "old" which makes it seem desirable, if it is the strangeness of the "new" which lays it open to suspicion, our job is clear. We must make the "new" familiar. We must see that innovations are made *clear.* We must help parents and other interested persons to *understand* our new procedures. If we will do that, resistance to change will be greatly reduced.

The Three R's Should Make Sense

Sometimes in our defense of changes in instructional content or procedures, we make the mistake of acting as if what had been done previously was all wrong. We act as if the new methods were entirely new. This is neither sound practice, nor is it good strategy in winning public understanding and support for changes.

The truth of the matter is that usually we retain much more of the old than our explanations indicate. We confuse the public and lay ourselves open to justifiable criticism when we contrast elements which should be complementary to each other. Some teachers made this error with respect to "teaching children vs. teaching subject matter." They said we should teach children, *not* subject matter. That is silly and also impossible. We teach subject matter *to* children. What we should have made clear to our public was that we were re-emphasizing the need to pay attention to the *child as the learner* as we sought to help him acquire *subject matter learning.*

In arithmetic nowadays we are emphasizing meaning and understanding. We decry meaningless drill of the routine, mechanical variety. But we have not discarded sensible amounts and types of practice in arithmetic. We have changed over to a stress on practice of arithmetic ideas and processes in meaningful settings. We stress practice accompanied by understanding and practice following understanding instead of drill for its own sake. It is important that we make clear to the parents that we have not discarded practice. We should make clear that we have shifted emphasis, not thrown out drill entirely.

The Three R's *should make sense.* Reading should make sense. Arithmetic should make sense. Writing (i.e., written expression) should make sense. That is a first consideration; but children are going to need practice in reading, in arithmetic, and in writing which makes sense. It behooves us to make this clear: We are not trying to dispense with practice in the skills; we are rather seeking to provide practice in understanding rather than practice on mechanics divorced from meaning.

We must not draw a line of controversy between meaning and practice. We must rather show how practice must be changed so as to make a greater contribution to understanding.

Teachers Must Themselves Understand

We who work in the field of education must realize that we will not do a good job of presenting our case to the public unless we ourselves have thought through to a clear understanding of what we are about. The teacher in the elementary classroom has small chance of teaching division of fractions to his pupils in a meaningful fashion unless he well understands the topic himself. That same teacher also has small chance of explaining his teaching methods successfully to the parents of his pupils unless he understands himself *what* he is doing and *why* he is doing it. A "half-baked" explanation is equally disastrous with parents and with pupils.

Going on, then, from the teacher's own understanding of what he is trying to do in the teaching of arithmetic, we might list many other characteristics of a good public relations program. But let us rather emphasize one and develop it in some detail. It is this: If we want the public to understand what we are trying to do in our schools, we must learn to talk to them in plain English. We must meet them on their own grounds and use common, everyday language.

This is not to suggest that we should "talk down" to the patrons of our schools —far from it. It is not necessary to "talk down" to them; they have a right to resent any such procedure. Rather, we should talk to them in the language of everyday conversation, unembellished with professional jargon. We need not oppose the use of a specialized vocabulary within the profession; every profession has its own brand. But let's keep it within our profession and even there let's be sure we are using it to *express* meanings rather than *conceal* them.

If we understand what we are about, we should be able to explain it to parents in everyday conversational language. If our language is direct and clear, if our illustrations seem reasonable and fit with

the experiences of our listeners, our "new" ways of teaching will not be so apt to sound *strange*. They can be made to seem like what they are—reasonable variations of past procedures in the direction of greater efficiency of teaching.

Our explanation of changes in teaching arithmetic should be consistent with the changes themselves. We say we are trying to teach arithmetic so it will "make sense" to children. Let us be consistent, then, and explain our work so it also "makes sense" to the parents.

The rest of this article will be devoted to examples of simple explanations which ought to "make sense" to teachers and parents and help both to see just what types of improvements are being recommended for arithmetic instruction these days. If parents understand what we are trying to do, they will not be so easily misled by careless or ill-informed critics.

Avoid Putting the Parent on the Defensive

As teachers we need to be very careful not to put parents on the defensive unnecessarily. Perhaps they have tried to help their children do arithmetic, using procedures by which they learned the same material. (Often the wide-awake teacher can pick up some excellent ideas for different approaches by talking with parents and other adults about how they were taught certain operations.) Let us assume that the teacher is working with the children on the early phases of reading, writing, and understanding decimal fractions and mixed numbers. Let us assume that a parent of one of the children has stopped after a P.T.A. meeting to talk with the teacher about the reading of decimal fractions.

The mother has been trying to help her child but has discovered that there is a difference in the way she does the work and the way the child is being taught at school. The mother was taught, as many of us were, that you can always tell what to call each place "by rule." That is, if you have one place to the right of the *decimal point*, you call that place "tenths." If you have 2 places to the right of the *decimal point*, you call that place hundredths."

The teacher, consistent with modern emphasis upon meanings of the number system and place value, has tried to minimize the decimal point and has emphasized ones' place instead. She has taught that the decimal point merely separates the whole number from the fraction part of a mixed number or serves as a sign that introduces a decimal fraction. She has helped children see that "tenths" and "tens" places balance evenly around the "ones" place because "tens" mean ten times as much as "ones" and because "tenths" mean one-tenth as much as "ones."

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How should the teacher handle this situation with the parent? First, she should NOT say this: "Well, the way you do it is wrong. It gives the wrong idea of place value. I am using the correct way. I wish you would try to do it at home the way I do it in school."

Please don't do that! Rather, the teacher might say something like this: "Yes, I know what you mean. The way you do it is the way I learned to do it myself. In fact, when I started teaching, I used to do it that way with the children. But you know, I found that many of the children had trouble. They couldn't see why 'tenths' place was only *one* place away from the decimal point when 'tens' place was *two* places away. Children forget the rule. I find that the children do not have this trouble when I emphasize the meanings of place value. Take the number 31.3 miles. I ask them about 'tenths' place: 'You have 3 tenths here. What is it 3 tenths of?' They answer that it is 3 tenths of one whole mile. They know it is not 3 tenths of the decimal point. So I continue reminding them that each decimal fraction is a fractional part of 1 whole thing. It makes it much easier to teach it that way."

Talking in this way with the mother puts her on the child's side, which happens also to be the teacher's side. The teacher recognizes that the mother learned it a different way and puts her at ease by sharing her own experience. Then the teacher presents the newer way of teaching by showing that it "makes sense" and by emphasizing how it helps the children. This way one can win a cooperating partner in Susie's education, not make an opponent of her.

Avoid Over Insistence upon Procedural Rules

Many teachers have a favorite way of writing work in arithmetic and insist that children must write their work *that particular way*. This is not a peculiar trait of mathematics teachers; English teachers sometimes have the same rigidity.

For example, the teacher may insist that the boys and girls always write the name of the answer as a part of the algorism. This may or may not be correct:

$$\text{Correct: } \begin{array}{r} 3 \text{ eggs} \\ \hline 4\,/12 \text{ eggs} \end{array}$$

$$\text{Incorrect: } \begin{array}{r} 3 \text{ eggs} \\ \hline 4 \text{ eggs}/\ 12 \text{ eggs} \end{array}$$

Or the teacher may insist that when a long division example has a remainder, the remainder must be written as a fraction as part of the answer. Again this may or may not be correct.

If 14 acres of land are to be divided equally among 4 people (assuming land value to be equal for the various parts of the tract), we find a quotient of $3\frac{1}{2}$ acres to be sensible. If, on the other hand, 14 children are to be seated at 4 tables and we want them to be evenly distributed, a quotient of $3\frac{1}{2}$ children is obviously not sensible. We will want to seat "at least" 3 children at each of the 4 tables, but the remainder of 2 children will be seated one each at two of the tables, giving us 4 children at two of the tables and 3 at two of them.

The teacher's insistence on a given written procedure which disregards the significance of the numbers is bad enough, but it becomes even worse when the parent who helps the child with his arithmetic homework (often Daddy) is *also* insistent, but insists on a different form from that used by the teacher.

This is a case where an ounce of prevention is certainly worth many pounds of cure. Teachers need to learn not to INSIST on specific written forms except when they are both CORRECT and NECESSARY. The teacher should desist from rules for rules' sake and should reason out *with* the children the best ways to write their work. In the case of the measurement division example, the written work could be related to a dramatized solution. The child could see that the answer "3" is the number of groups of 4 eggs, and will see that it does not make sense to write "3 eggs" as the answer.

In the case of the remainder, he will see that we decide how to write the remainder in terms of what we would really do in the given situation. In fact, children are quick to see the humor in wrong use of fractional remainders for items which they would really never divide into fractional parts.

The same holds true for parents. If we have a logical reason worked out with the children, the children themselves can explain to their parents why or why not a remainder is written a certain way.

Take Time to Clarify with the Children What You Are Doing

Sometimes we get some adverse criticism of our teaching because we have not taken pains to make clear to the children what we are about. A recent critic attacked teachers of reading for teaching children "to guess" words; many parents are convinced that he is right. Perhaps we had better mend our fences on "guessing" in arithmetic. The writer has known of a few cases in which teachers have attempted to teach children to round off

numbers and estimate answers but have been reported as teaching children to "guess" answers.

There is a fundamental difference between the commonly accepted meaning of "guessing" and the approximation of numbers or estimation of answers in arithmetic. When children are taught to estimate answers, it should be made quite clear to them (and to their parents) that random "guessing" is out of place. Estimation of answers should serve two purposes: (1) it helps us get an approximate answer quickly; (2) it helps us check on the reasonableness of answers arrived at by usual computational methods.

Actually, we have no contradiction here between a stress on accuracy of computation and skill in approximation. That is, there is no contradiction if the children and the parents understand what we are about.

Sometimes, teachers themselves are not as skillful in approximation as they should be in order to be good guides in developing this skill. Sometimes we are too much bound to pencil-and-paper arithmetic to function well with non-written calculations.

This is an area which has so many practical applications that it is really an excellent one through which to demonstrate to parents the practical nature of arithmetic learning in school. Take a community in which there is a 4% sales tax. Rounding off the total of one's purchases at the grocery store to even dollars and multiplying "mentally" by 4 is of practical everyday value. If Mrs. Smith's Jimmy can do that for her when he accompanies her to the supermarket, she will be favorably impressed with what he is learning at school. If, on the other hand, he makes wild guesses at answers instead of reasonable estimates, she will be just as unfavorably impressed.

The old stumbling-block of how to "point off" answers in division of decimal fractions and mixed numbers is also a case in point. If Willie in doing his "home-work" sprinkles decimal points at random among his quotients, parents may well be concerned about his "guessing." While it is by no means the whole solution for such a problem, the teaching of approximation rather than guessing would give Willie a great deal of help here. He would know when he "points off" a quotient whether he had a reasonable answer or not.

Whether the charge of guessing may be justified or not, let us be very careful that we teach estimation as a common sense, practical process, not as guessing. If we do that, we can explain the true situation without embarrassment and with benefit to all concerned.

Assignments of Home Work Are Part of Public Relations

Reference has already been made to "home work" in arithmetic. The home work assignments we make have much to do with parents' understanding or lack of understanding of what we are trying to do in schools.

Take, for example, the teacher who, as home work in arithmetic, asked her pupils to copy down in column form the telephone numbers of all the lawyers in town, then add them. The next assignment was to copy and add the phone numbers of all the doctors.

Contrast with that assignment this one given by a teacher late in the school year and just preceding summer vacations. Several pupils had told of family plans for trips by automobile. The teacher asked the children to use road maps of the type available in gasoline stations. She asked them to add mileages to check on most direct routes to follow in going from the home city to each of several other points of interest to the children.

No parent of average intelligence would have any hesitation in deciding which of these two teachers was having her pupils practice addition in a more practical situation.

If we but realized it, the routine mechanical home work in arithmetic could

so easily be supplanted by a type of home work which would be not only a benefit to the children in their learning of arithmetic, but also an avenue to good public relations with the home. Home work should not usually be just a repetition of practice exercises which might just as well be done at school. It should be a type of activity which can be done at home better than at school. Take the topic of measures. In a rural community, the home farm is a "happy hunting ground" for investigating practical uses of measures like bushels, acres, cubic feet, square yards, or tons. Home is the proper place for the farm boy or girl to investigate these measures. Parents will be glad to help with this kind of home work and pleased that the teacher thinks it is important. Of course, the teacher had better know that a bushel of oats and a bushel of corn have different weights; if she doesn't, some young farmer will set her straight in a hurry. The child whose father is a railroad engineer can find out about measures to which the farm boy does not have access.

Yes, the children's home and parents can be a rich resource for the learning of arithmetic if the teacher has a wide-awake concept of what home work CAN be.

Summary

In summary, let us restate the major points which have been stressed above:

1. As we seek to teach arithmetic so that it makes sense to children, we should also seek to present our teaching methods to the public so they also will make sense.
2. If teachers are to do this, they must themselves understand rather clearly what they are about and why they are doing as they do.
3. In setting up a good public relations program for the teaching of arithmetic, we need to consider more points than space allows; but these suggestions should be part of such a program:
   a. Avoid putting the parent on the defensive. (Do not suggest that his methods are all wrong.)
   b. Avoid over-insistence upon particular rules of form and procedure. (E.g., *always* writing answers in a given way.)
   c. Take time to clarify with the children just exactly what is being done, so that they can present an accurate picture at home. ("Guessing" is not the same as "estimating.")
   d. Make "home work" in arithmetic a part of a good public relations program.

Conclusion

These suggestions are by no means a complete coverage of ways and means by which teachers of arithmetic can help parents to understand what a modern program of teaching arithmetic is. They represent, rather, a few lines of activity which should be of help in convincing parents that we do know what we are about in our schools, that we do not make changes merely for the sake of making changes, and that we are sincerely interested in teaching arithmetic to boys and girls in such a way that it will make sense to them now and for the rest of their lives.

Some people may say this article assumes that elementary school teachers are further advanced in their teaching procedures in arithmetic than they actually are. That may be true in some cases. If so, a first step for such teachers is one of catching up with developments in this field.

No one of us knows absolutely or completely how to teach arithmetic. As a group, we know much better than we did a generation ago. Let's do our part to see that the next generation of teachers does still better. And wherever we are along the line of progress, let's take parents into our confidence about what we are trying to do. They can be a big help to the children and to us.

The Elementary School Mathematics Library

A Selected Bibliography

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CONTINUAL GROWTH IN UNDERSTANDING mathematical ideas is dependent upon a wide variety of experiences used to enrich and stimulate further interest and activity on the part of the learner. The elementary school library is an excellent source of quantitative ideas, described both pictorially and symbolically, that go beyond the systematic study materials used in most arithmetic classes.

The purpose of this selected collection of books is to suggest to elementary school teachers some of the books that may be used as a source of information, as enrichment of basic instructional materials, and as recreational reading. Exact grade placement is difficult to suggest because of the variation found in reading ability among children and in the way in which some of these books may be used. However, as a help to the reader, an attempt has been made to recommend suitable grade levels. Both recommendations and brief annotations have been based on an examination of each book selected for this list.

* Supervisors in the Elementary Laboratory School, teaching in primary, lower intermediate, and upper intermediate grades, respectively. Lauretta G. McCusker, Department of Library Science, and E. Glenadine Gibb, Department of Mathematics, Iowa State Teachers College, assisted the writers in making the selections to be included in this collection and in the preparation of the manuscript.

Primary Grades

	Grade	Price
BEEBE, CATHERINE. THE CALENDAR. 63 pp. 1940. Oxford University Press[1]. Children make a calendar to show interesting events in each month. The purpose is real and the experiences are meaningful. Provides an introduction to understanding a calendar.	1, 2	$1.25
BERKOWITZ, ETHEL S. THE SIZE OF IT. (Ethel S. Berkley, pseud.) Illustrated by Kathleen Elgin. 25 pp. 1950. Interesting text and pictures provide concepts of: what is little, big, long, tall, wide, narrow, short. May be read to children in kindergarten and first grade. Some children in second grade read it for themselves.	K, 1, 2	1.25
BERKOWITZ, ETHEL S. UPS AND DOWNS. (Ethel S. Berkley, pseud.) Illustrated by Kathleen Elgin. 25 pp. 1951. Scott. This simply written book presents some of the easier space concepts. Pictures and context give meaning to up, down, high, low, top, bottom, under, and over. Kindergarten and first grade children will enjoy having it read to them and will like the pictures. Children in second grade can read it themselves.	K, 1, 2	1.25

[1] Publishers and their addresses are listed at the end of this section.

	Grade	Price
BIANCO, PAMELA. THE DOLL IN THE WINDOW. 32 pp. 1953. Oxford University Press	1, 2	2.00
A little girl saved her pennies to buy Christmas presents for her five sisters. She had to make the following decisions: how much she must save to buy each a ten-cent gift; how much she could spend on each with the dollar she had saved. The story also conveys the idea of graduated sizes as illustrated by the wooden doll which contained five dolls of decreasing size. May be read to children in first and second grade.		
BRANN, ESTHER. FIVE PUPPIES FOR SALE. 80 pp. 1948. Macmillan	1, 2, 3	1.75
An interesting story, supposedly told by a little girl, of a family of puppies belonging to her and her brother. Good number concepts of one through six are conveyed through picture and text. Can be read by children in third grade and some in second grade. Children in first grade would enjoy having it read to them.		
BROWN, MARGARET WISE. TWO LITTLE TRAINS. 24 pp. 1949. Scott	1	1.75
This is a story of two little trains going out west. It may be useful as an additional means of conveying concept of two, down (as down the track), long, through, over (meaning across), below, around, and beyond. To be read to children in first grade.		
EICHENBERG, FRITZ. DANCING IN THE MOON—Counting Rhymes. np. 1955. Harcourt	K, 1, 2	2.25
This is a picture book with one line of text on each page. Each sentence contains a rhyme and each picture and sentence contains one number idea. Numbers used are from 1 through 20. Some of the pictures show groupings quite clearly. Others might be hard for young children to see.		
FRISKEY, MARGARET. CHICKEN LITTLE COUNT-TO-TEN. Pictures by Katherine Evans. 28 pp. 1946. Children's Press	K, 1	1.00
A little chicken didn't know how to drink. Good concepts of one through ten are conveyed through pictures and text as the chick meets one cow, two elephants, three camels, four colts, five pigs, six toads, seven monkeys, eight kittens, nine puppies, and ten foxes. To be read in kindergarten. Some children in first grade may enjoy reading it themselves.		
GAG, WANDA. MILLIONS OF CATS. 30 pp. 1945. Coward-McCann	K, 1, 2	1.20
This old favorite contains a number of descriptions and situations that might be used to strengthen certain ideas, such as, around, over, through, a long, long time, hundreds, millions, billions, trillions.		
HOGAN, INEZ. TWIN LAMBS. 44 pp. 1951. Dutton	K, 1, 2	1.25
Twin lambs wandered away from the flock. The following number concepts are to be found in the story: flock, a short-distance away, a long way from the flock, same shape, same size. Read to children in kindergarten and first grade. Children in second grade may read it themselves.		

	Grade	Price
HOGAN, INEZ. WE ARE A FAMILY. 93 pp. 1952. Dutton. Story may not have great interest appeal for primary children. However, pictures provide good number concepts of one through six. May also be used in making comparisons of size of these baby animals—beavers, eagles, polar bears, and mice.	1, 2, 3	2.75
KARASZ, ILONKA. THE TWELVE DAYS OF CHRISTMAS. np. 1949. Harper. In this beautifully illustrated old song, the same grouping is repeated in a sequence of pictures. As the story builds and each verse is enumerated, these groups become so familiar that they are easily identified.	K, 1	1.75
LEAF, MUNRO. ARITHMETIC CAN BE FUN. 64 pp. 1949. Lippincott. This amusing book by Munro Leaf is devoted entirely to number concepts. It begins with some reasons why arithmetic is important and ends with addition and subtraction facts through 18. Also included are ideas invloving measurement, time, and fractions. Different parts of the book may be used effectively with children in each of grades 1, 2, and 3.	1, 2, 3	1.75
MONRAD, JEAN. HOW MANY KISSES GOODNIGHT. 19 pp. 1949. Scott. This book for very little children conveys a feeling of warmth and love and security. It is especially nice for bedtime reading. Simple number concepts are imparted by calling attention to numbers of toes, fingers, ears, lips, etc.	K or younger	1.00
SCHLEIN, MIRIAM. THE FOUR LITTLE FOXES. Illustrated by Lois Quintailla. 34 pp. 1953. Scott. Four little foxes are taught by their father all the things little foxes should know. This book is excellent to use when developing the concept of four. There are thirteen different full-page pictures in the book which show groups of "four" or "four and one" or "four and two." Read to children in first and second grade.	1, 2	2.00
SCHLEIN, MIRIAN. HEAVY IS A HIPPOPOTAMUS. Illustrated by Leonard Kessler. 30 pp. 1954. Scott. This book is good to use when helping young children in their understanding of weight. Many weight concepts are presented, as, pushing and lifting something heavy, what is heavy for a small animal or person would be light for larger ones, and units for measuring weight—ounce, pound, ton.	K, 1, 2	1.75
SCHNEIDER, HERMAN AND NINA. HOW BIG IS BIG. Illustrated by A. F. Arnold. 40 pp. 1950. Scott. This book for small children is devoted to the task of clarifying the concepts of bigness and smallness. Illustrations of bigness include boy, elephant, tree, skyscraper, mountain, moon, earth, sun, stars. Illustrations of smallness include boy, dog, mouse, flea, mite, protozoa, algae, atoms, protons, neutrons, electrons. Although good, this book may have gone too far in each direction of size for little children.	1, 2, 3	1.75

	Grade	Price
SEUSS, DR. McELLIGOT' & POOL. 52 pp. 1947. Random..... This is a typically delightful Dr. Seuss story about a little boy who imagines what he may catch as he fishes in a very small pool. Contains ideas of great length, large numbers of things, different shapes, height, depth, and size. Read to children in first and second grade. Children in 3rd grade may read it for themselves.	1, 2, 3	2.50
SKAAR, GRACE. THE VERY LITTLE DOG. 19 pp. 1949. Scott. Very simple text tells the story of a little dog. Both picture and text are used to describe his growing bigger and bigger. Might be used as an experience for developing the idea of little and big through both the senses of seeing and hearing.	K	1.00
STEINER, CHARLOTTE. THE BIG LAUGHING BOOK. 56 pp. 1949. Grosset..... This picture book contains rhymes, riddles, stories, matching games, etc. Some of the pictures and situations in the book include concepts of space, size, length, and quantity.	1, 2, 3	1.00
TODD, MARY FIDELIS. ABC AND 1 2 3. 27 pp. 1955. McGraw... This is a combination alphabet and number book. It provides opportunity for counting and grouping experiences. Suggest that it be read to first and second grade classes.	1, 2	2.00
TRESSELT, ALVIN. FOLLOW THE ROAD. Illustrated by Roger Duvoisin. 26 pp. 1953. Lothrop, Lee, and Shepard..... Ideas of space, tempo, quantity, and size are used to tell the story of a little boy who decides to take his wagon and follow the road. Suggest that it be read to children in first grade. Some children in second grade may enjoy reading it for themselves.	1, 2	2.35
WEISSENBOR, H. COUNTING. 26 pp. 1948. Acorn..... This is an interesting picture book containing groupings through twenty and the multiplication tables. Groupings through ten are good. Materials beyond that are somewhat indistinct for small children. The first few pages might be used effectively with children in first and second grades.	1, 2	1.80
WOOLEY, CATHERINE. TWO HUNDRED PENNIES. 128 pp. 1947. Morrow..... A seven-year old saves his pennies to help buy enough track for an electric train. The story helps develop the concept of the number of pennies in a dollar. The beginning concepts of addition and subtraction are introduced. These number experiences are real and meaningful.	1, 2, 3	2.00

Lower Elementary Grades (or above)

BEHN, HARRY. ALL KINDS OF TIME. np. 1950. Harcourt.... The text of this book is fanciful and poetic. Provides time concepts of seconds, minutes, hours, days, weeks, months, seasons, years, centuries. Might be used to motivate the problem, "What measuring instruments are used to measure time?"	3 or above	2.00

	Grade	Price
BRAGDON, L. J. TELL ME THE TIME PLEASE. np. 1936. Lippincott. This book gives an explanation of the history of telling time, that is, by stars, shadows, water clocks, the hour-glass, and finally the clock. Consideration is given measurement of time around the world and the difference in time in the zones of the United States. This is an enjoyable way to learn the history of time and to understand time around the world. Opportunity is given for the actual reading of time.	3, 4	1.50
BRINDZE, RUTH. THE STORY OF OUR CALENDAR. 64 pp. 1949. Vanguard. A description of the different calendars developed through the ages shows how people kept track of time according to the sun, moon, and stars. Other topics of possible interest are international date line, Greenwich time, latitude, and longitude. Source of informative material through interesting reading for the individual.	3–6	2.50
FENTON, CARROLL LANE, and FENTON, MILDRED ADAMS. WORLD IN THE SKY. 96 pp. 1950. Day. This simple book on astronomy gives factual information concerning the sun, planets, moon, and stars. An interesting description of the reasons for day and night, for the changes in seasons, and the eclipses of the sun and moon. Introduces ideas of distance and size.	3, 4	2.50
FLYNN, HARRY EUGENE, and LUND, CHESTER BENFORD. TICK-TOCK, A STORY OF TIME. 234 pp. 1938. Heath. This book describes the time-telling devices from the time of the cave dweller to the clocks of today.	3, 4	.88
HUFFMAN, PEGGY. MISS B'S FIRST COOKBOOK. 43 pp. 1950. Merrill. A child's cookbook with family-size recipes gives concrete and satisfying use of measurement in meaningful situations. Recognition and use of simple fractions are necessary in determining quantity for number to be served from the recipe.	3, 4	1.75
LACH, ALMA S. A CHILD'S FIRST COOKBOOK. 96 pp. 1950. Hart. This child's cookbook is written in simple language. Pictures show the equipment needed for the recipes, ingredients in exact quantity, and ideas of liquid and dry measure. Use of recipes in the book depends upon the understanding of simple fractions.	3, 4	1.25
LEEMING, JOSEPH. FUN WITH PUZZLES. 128 pp. 1946. Lippincott. In this book written for those interested in the wide and fascinating world of puzzles, there is a collection of both number and mathematical puzzles. These should have appeal for individual and class use if selected for child interest and ability.	4 or above	2.00

	Grade	Price
LEEMING, JOSEPH. MORE FUN WITH PUZZLES. 149. 1947. Lippincott. This book of number puzzles includes cut and put together, pencil and paper, match, word and letter, number and mathematical puzzles. Solutions require imagination, logical reasoning, and clear thinking. This book should furnish good teacher material to provide fun and interest for group work. The more mature thinkers will find it a challenge and will be able to solve many of the puzzles independently.	3 or above	2.50
NORMAN, GERTRUDE. THE FIRST BOOK OF MUSIC. 65 pp. 1954. Watts. Although this book gives a brief description of early music, instruments, and contains a list of good music on records, a few pages give some excellent illustrations of applications of mathematics to music in a study of rhythm, counting time, and building melodies.	3, 4	1.75
SCHLOAT, G. WARREN. ADVENTURES OF A LETTER. 48 pp. 1949. Scribner. Pictures and captions are simple and give an accurate description of each step in the journey of an airmail letter, as it travels 3,000 miles in less than 24 hours, by truck, helicopter, plane, train, and by foot. The number of people involved, the weight of the mail pouch, actual flying time, time of arrival and departure at each stop en route require a concept of number. Comprehension depends upon the understanding of time, weight, distance. This is also a valuable book for social studies showing the inner workings of the post office.	3, 4	2.00
SMITH, DAVID EUGENE. THE WONDERFUL WONDERS OF ONE-TWO-THREE. 47 pp. 1937. McFarlane. A history of our number symbols which gives an account of the naming of numbers and the early use of numbers. The possible origin of Roman numerals, several fascinating number puzzles, and evidence of numbers in nature are included. This is an enjoyable book especially for the child who finds numbers intriguing. Also provides materials for developing an interest in numbers.	3 or above	1.00
TOWNSEND, HERBERT. OUR WONDERFUL EARTH. 152 pp. 1950. Allyn. A story, telling how the earth became the great round earth it is today, uses numerous instances for developing ideas of space, distance, number of days in year, change of seasons, measurement of distance on the earth, height, and size by comparison.	3 or above	2.00
WERNER, ELSA JANE. THE GOLDEN GEOGRAPHY BOOK. 96 pp. 1952. Simon and Schuster. A child's introduction to the world provides for developing ideas of time in relation to day and night, numerous instances of size by comparison. An interesting book in which information is made realistic through illustration.	3, 4	3.95

	Grade	Price
ZARCHY, HARRY. LET'S MAKE SOMETHING. 158 pp. 1941. Knopf	3, 4	1.75

This book illustrates the use of mathematics to create form and design for making things from such materials as wood, clay, plaster, soap, wax, paper, glass, and metal. Instructions are given for selected crafts.

Upper Elementary Grades

ANDREWS, F. E. NEW NUMBERS. 168 pp. 1935. Harcourt	6	2.00

A case is built for changing from the present number system to one using 12 as a base. This book may be of interest to a gifted child who is motivated to learn of the history and basis of our conventional number system.

BENDICK, JEANNE. HOW MUCH AND HOW MANY. 188 pp. 1947	5, 6	2.50

This story of weights and measures gives both historical background and modern-day applications. Special measures used in exact sciences such as ballistics, electricity, weather, medicine, photography, time, etc. are included. Clever line drawings and easy reading make this book interesting and attractive.

BUFF, MARY and CONRAD. BIG THREE. 80 pp. 1946. Viking	5, 6	3.00

This is a story of the life of a giant redwood tree, his friends and enemies through the centuries. Further develops the concept of time and size. Beautifully written in a style which is particularly suitable for reading aloud by the teacher. For enrichment.

FOWLER, H. WALTER, JR. KITES. 92 pp. 1953. Barnes	5, 6	1.75

Descriptions of various types of kites with explanations of how to make and fly them. Comprehension of directions depends upon understanding of linear measure, cubic measure, weight, and knowledge of geometric figures. Source of material and information to satisfy individual interest and need.

FREEMAN, MAE and IRA. FUN WITH FIGURES. 60 pp. 1946. Random	5, 6	1.50

Fun to do experiments with triangles, squares, circles, and other shapes, designed to develop understanding of characteristics and use of these common geometric figures.

HADDLETON, MAUD. NUMBERS. Mimeographed. 30 pp. IACS	5 or above	.50

This is a collection of facts and drawings about figures, computing devices, money, weights, and measure.

LEEMING, JOSEPH. FROM BARTER TO BANKING. 131 pp. 1940. Appleton	5, 6	2.00

Factual material with historical background is used in the story of the development of money from barter to banking. There are descriptions of many different kinds of money that have been used and are still being used over the world. Source of information for both group and individual problem-solving experiences.

	Grade	Price
MARSHAK, ILIN. WHAT TIME IS IT? (M. Ilin, pseud.) 132 pp. 1932. Lippincott. This story of clocks describes man's efforts to measure time through the years. Includes pictures and descriptions of how such measuring devices as the sun, steps, gnoman, ordinary walking stick, sundial, water clock, milk clock, sand clock, rooster, trumpet, fire clock, candle were used to measure time. Interestingly written.	5, 6	$2.00
PARKER, BERTHA MORRIS. HEAT. 36 pp. 1942. Row, Peterson. The story of heat describes its effects, uses, and ways of traveling as well as means of measuring heat by different scales. It is a source for solving specific individual and group problems of interest regarding heat.	5, 6	.28
SMITH, DAVID EUGENE. NUMBER STORIES OF LONG AGO. 160 pp. 1919. NCTM. This combination of history and facts, written in an interesting way, includes how numbers have assisted in solving the world's problems through the centuries, the attempts to count, and experiments in writing numerals and performing computations. Also includes number puzzles and curious problems. Excellent for teacher presentation.	5 and above	.75
SMITH, DAVID EUGENE, and GINSBERG, J. NUMBERS AND NUMERALS. 62 pp. 1937. This story of numbers gives an account of the history of number—how our numbers came into use, how some of the numerals came to have their present shape, how different number scales were used, how numbers were named. Also of interest are some early methods of computation and number mysticism.	5 and above	.35

Directory of Publishers

ABINGDON-COKESBURY. Abingdon-Cokesbury Press, 810 Broadway, Nashville 2, Tenn.

ACORN. Acorn Publishing Company, Inc., 9-13 Front Street, Rockefeller Center, N. Y.

ALLYN. Allyn and Bacon, Inc. (Subsidiary of Prentice-Hall, Inc.), 70 Fifth Avenue, New York 11, N. Y.

APPLETON. Appleton-Century-Crofts, Inc., 35 West 32nd Street, New York 1, N. Y.

BARNES. A. S. Barnes & Company, 232 Madison Avenue, New York 16, N. Y.

CHILDREN'S PRESS. Children's Press, Jackson Blvd. and Racine Avenue, Chicago 7, Ill.

COWARD-MCCANN. Coward-McCann, Inc., 210 Madison Avenue, New York 16, N. Y.

CROWELL. The Thomas Y. Crowell Company (in association with Studio Publications), 432 Fourth Avenue, New York 16, N. Y.

DAY. John Day Company, Inc., 62 W. 45th Street, New York 36, N. Y.

DUTTON. E. P. Dutton & Company, Inc., 300 Fourth Avenue, New York 10, N. Y.

GROSSET. Grosset & Dunlap, 1107 Broadway, New York 10, N. Y.

HARCOURT. Harcourt, Brace & Company, Inc., 383 Madison Avenue, New York 17, N. Y.

HARPER. Harper & Brothers, 49 East 33rd Street, New York 16, N. Y.

HART. Hart Publishing Company, 114 E. 32nd Street, New York 16, N. Y.

HEATH. D. C. Heath & Company, 285 Columbus Avenue, Boston 16, Mass.

HOLT. Henry Holt & Company, Inc., New York 17, N. Y.

I.A.C.S. Industrial Arts Cooperative Service, 519 W. 121st Street, New York, N. Y.

KNOPF. Alfred A. Knopf, Inc., 501 Madison Avenue, New York 22, N. Y.

LIPPINCOTT. J. B. Lippincott Company, E. Washington Square, Philadelphia 5, Penn.

LOTHROP. Lee & Shepard Company, Inc., 419 Fourth Avenue, New York 16, N. Y.

MCFARLANE. McFarlane, Warde & McFarlane, Inc., 213-215 Cayuga Street, Fulton, N. Y.

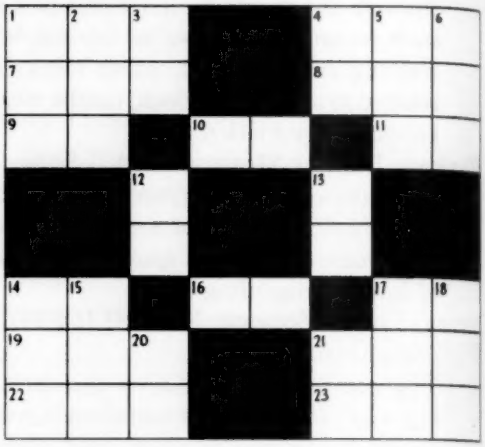
MCGRAW. McGraw-Hill Book Company, Inc., 330 W. 42nd Street, New York 18, N. Y.

MACMILLAN. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y.
MERRILL. Charles E. Merrill Books. Affiliated with American Education Publications.
MORROW. William Morrow and Company, Inc., 425 Fourth Avenue, New York 16, N. Y.
NCTM. National Council of Teachers of Mathematics, 1201 Sixteenth Street, N. W., Washington 6, D. C.
OXFORD. Oxford University Press, Inc., 114 Fifth Avenue, New York 11, N. Y.
RANDOM. Random House, Inc., 457 Madison Avenue, New York 22, N. Y.
ROW, PETERSON. Row, Peterson Company, 1911 Ridge Avenue, Evanston, Ill.
SCOTT. Scott, Foresman and Company, 433 East Erie Street, Chicago 11, Ill.
SCRIBNER. Charles Scribner's Sons, 597 Fifth Avenue, New York 17, N. Y.
SIMON AND SCHUSTER. Simon and Schuster, Inc., 630 Fifth Avenue, New York 20, N. Y.
VANGUARD. Vanguard Press, 424 Madison Avenue, New York 17, N. Y.
VIKING. The Viking Press, Inc., 18 E. 48th Street, New York 17, N. Y.
WHITTLESEY HOUSE. (See McGraw-Hill Book Company.)

EDITOR'S NOTE. This bibliography of supplemental "reading-reference-learning" books for the enrichment of arithmetic and mathematics in the elementary school grades has been requested by a number of schools and teachers. The editor suggests that teachers check their school libraries and then make a selection of these books which they keep available for their pupils. It is often some little item of interest which a youngster finds in a book or learns from some other person which stimulates his curiosity and gives him the impulse to extend his learning. It is not always the so-called bright pupil who finds something to whet his interest in a reference book. Many of these books have a comparatively easy vocabulary and their pictorial presentation makes them appealing to children. More and more teachers are realizing the interdependence of the various branches of learning and the way in which study in one area can supplement another. We are indebted to these Iowa teachers who have prepared this carefully annotated bibliography. Perhaps they or another group will prepare a similar list in 1957 so that school libraries may be kept up to date. If some books that teachers have found particularly good as supplementary arithmetic have been omitted from the current list, the editor would like their titles so that they too may be called to the attention of readers.

Cross Figure Puzzle—Measures

GEORGE JANICKI
Elmwood Park, Illinois



ACROSS DEFINITIONS

1—$\frac{1}{4}$ of a mile in feet
4—1/10 of a mile in feet
7—A certain type of fire alarm
8—$14\frac{1}{2}$ minutes in seconds
9—A dozen
10—Number of ounces in 1 pound
11—Baker's dozen
14—Ounces in pound (Troy system)
16—A full day in hours
17—6 feet 5 inches expressed in inches
19—$466 \times 1 + 0 =$
21—Largest 3 place whole number
22—A 1/12 of a mile in feet
23—$19 \times 3 \times 4 \times 4 =$

DOWN DEFINITIONS

1—Product of 23 and 27
2—$38\frac{1}{4}$ pounds changed to ounces
3—A penny in decimal form
4—5 feet less 2 inches in inches
5—$100 \times 2.71 =$
6—$3212 \times \frac{1}{4} =$
12—One hour in minutes
13—3 feet in inches
14—A gross
15—22 dozen is how many units?
17—An odd number
18—An even number
20—5 feet tall is how many inches?
21—Largest 2 place whole number

Whither Research on Compound Subtraction?

(A Communication to the Editor)

J. FRED WEAVER
Boston University School of Education

YOUR NOTE FOLLOWING a recently published research article on compound subtraction by Rheins and Rheins in THE ARITHMETIC TEACHER[1] was a significant one in several respects. Most importantly, it directed attention to the complexity of factors which must be considered in any comprehensive evaluation of the relative merits of methods of compound subtraction.

Somewhat unfortunately, very few of these factors were taken into account in research on this question prior to the commendable work of Brownell and Moser[2] which was reported in 1949, but was not mentioned by the Rheins in their article. Up to that time, although the many previous investigations differed in numerous respects, the vast majority of them had three significant things in common: (1) they based their findings and conclusions on measures of speed and accuracy of performance exclusively, (2) they included many, and sometimes all subjects who were well beyond the initial learning stages for the skill investigated, and (3) they dealt with children and adults who, we have good reason to infer, had been taught and had learned compound subtraction in a mechanical way. Among these earlier investigations (which have been reviewed critically in the Brownell-Moser monograph), the great preponderance of experimental evidence showed equal additions to be superior to decomposition, with the advantage in speed more pronounced than the advantage in accuracy.

It is interesting to note that despite this fact, teacher-preference definitely favored the decomposition method. In 1934 Wilson[3] reported the results of a questionnaire study which revealed that in the United States the ratio of teachers teaching decomposition to those teaching equal additions was $2\frac{1}{2}$ to 1. Today, of course, the decomposition method is taught far more exclusively in this country. Only in certain foreign countries do we now find the situation more or less reversed, with definite teaching preference and practice favoring either the equal additions or the Austrian methods.[4]

As far back as 1925, Knight, Ruch, and Lutes[5] deplored the narrow evaluative base upon which existing research up to that time had rested: upon speed and accuracy exclusively. These writers reasoned that other significant factors and criteria, almost wholly neglected up to that time, have an important bearing upon any decision to adopt a specific method as the "superior" one.

This thoughtful view was not reflected to any extent in the trend and nature of research on compound subtraction, however, until Brownell and Moser conducted their investigation. Here was the first serious and successful attempt to broaden

[1] Gladys B. Rheins and Joel J. Rheins, "A Comparison of Two Methods of Compound Subtraction: The Decomposition Method and the Equal Additions Method." ARITHMETIC TEACHER 2: 63–69; October 1955.

[2] William A. Brownell and Harold E. Moser, *Meaningful vs. Mechanical Learning: A Study in Grade III Subtraction.* Duke University Research Studies in Education, No. 8, Durham, N. C.: Duke University Press, 1949. 207 p.

[3] Guy M. Wilson, "For 100% Subtraction, What Method? A New Approach." *Journal of Educational Research* 27: 503–508.

[4] The Austrian method, of course, is fundamentally the equal additions principle coupled with an additive language pattern.

[5] F. B. Knight, G. M. Ruch and E. O. Lutes, "How Shall Subtraction Be Taught?" *Journal of Educational Research* 11: 157–68.

the evaluative base to include consideration of important factors such as: the nature of children's arithmetic background ("meaningful" or "mechanical") prior to study of compound subtraction; the nature of the teaching-learning procedure (meaningful vs. mechanical) while working with the new skill; the degree of understanding of the mathematical basis for the new skill; the level of maturity and smoothness of performance reflected in verbalized thought patterns when working with compound subtraction; the extent of transfer of newly acquired learning to related but "untaught" subtraction situations; and the retention of learning after a lapse of time.

Data from the Brownell-Moser study, based on numerous measures collected in four independent experiments involving 1400 children in 41 classes, warrant the following two major conclusions, among others:

(1) For instructional programs in which the teaching-learning situation was mechanical and authoritative, the general tendency was for equal additions to be significantly more efficient than decomposition. This is in agreement with the vast majority of previous research findings which, we have good reason to infer, were based on data from children and adults who had been taught and had learned compound subtraction mechanically rather than meaningfully.

(2) On the other hand, for instructional programs which emphasized mathematical understandings and related meaningful teaching-learning procedures; for situations in which instruction and learning were evaluated on a broad base which included measures of understanding, of transfer, and of long-term retention, as well as conventional measures of speed and accuracy of performance,—in cases such as these, decomposition was found to be preferable and superior to equal additions. This finding gives sound and comprehensive research evidence in support of our virtually universal decision in the United States today to initiate instruction in compound subtraction (in Grade III) on a meaningful basis using the decomposition procedure.

Now, the Rheins report further research evidence which they interpret as favoring use of the decomposition method at the outset of instruction in compound subtraction: ". . . for the more intelligent group [of children in their sample], the decomposition-method was not inferior; whereas for the less intelligent group the decomposition method proved to be superior."[6] They further conclude that: "The results of this study seem to bear out the arguments of the proponents of developmental mathematics that teaching meaningfully produces superior results especially with duller pupils."[7]

Welcome as these conclusions might be to one who is a staunch believer, as I am, in the meaningful teaching of the decomposition procedure to children in Grade III, frankly it must be recognized that neither of the two conclusions may be warranted at all. In the first place, the Rheins secured their data from eighth-grade children who were five years removed from initial instruction in compound subtraction. Despite the reasons cited for using this sample, it is not necessarily at all valid to infer, as the Rheins have done, that children should be taught a procedure in Grade III because that procedure was found to be either "not inferior" or "superior" among children at the eighth-grade level. The preferable method *ultimately* is not *necessarily* the preferable method *initially*. In fact, when the results of the Brownell-Moser study (involving children in Grade III) are interpreted in light of the preponderance of evidence from earlier investigations (involving, for the most part, children in the upper grades, or adults), it would appear that the preferable method initially (i.e., decomposition) may *not* be the preferable method ultimately (i.e., equal additions).

[6] Rheins and Rheins, *op. cit.*, p. 67.
[7] *Ibid.*

In the second place, the Rheins data do not necessarily tell anything about the value of *meaningful* teaching. It was *inferred* that instruction in compound subtraction had been meaningful in nature. Probably it was; however, it *could* have been quite mechanical. Without specific indication of the nature of instruction in compound subtraction during previous years (especially in Grades III and IV), any inference the Rheins draw from their data regarding the value of meaningful instruction is definitely unwarranted.

Even overlooking the fact that the Rheins investigation involved a rather small sample (less than 20 matched pairs in each of two groups), there also are other conditions which undoubtedly affect the reliability and validity of their findings and conclusions to an undetermined degree. For example, the "accuracy" comparison between the decomposition and equal additions methods was based on data from an 8-minute test of 22 abstract subtraction examples (Test A). However, *36%* of these items involved *no* compound subtraction. A *few* such examples would be justified for obvious reasons. However, we rightfully may ask how well the accuracy of the decomposition and equal additions methods can be compared using an instrument in which only 64% of the items are of the type that could differentiate between the things being measured.

There is no need to elaborate further along these lines. Enough has been said to emphasize the fact that caution must be observed when considering the results reported from the Rheins investigation, and to give a basis for interpreting the significance of this study, its findings and its conclusions in relation to other research on compound subtraction.

As has been said, your thought-provoking Editor's Note directed attention to the complexity of factors which must be considered in relation to methods of compound subtraction. The Brownell-Moser study has been the most significant one to date with regard to many of the points you emphasized. Certain questions remain unanswered, to be sure. These well may be the object of fruitful future research.

One interesting possibility along this line was suggested by Brownell and Moser in their monograph,[8] and subsequently was proposed again by Moser in another connection. In the latter instance the problem has been posed in the following manner:

> "We know from studies conducted by Brownell that third-grade children profit more from subtraction taught meaningfully by the decomposition method than from equal additions taught meaningfully. Johnson and others have shown that the process of equal additions is more efficient at the adult level. Where, in the arithmetic curriculum, can we teach children to change from decomposition to equal additions with a minimum of confusion and interference?"[9]

Parenthetically, it should be noted that the Rheins definitely misinterpreted the sense of this specific proposal by Moser when they stated: "H. E. Moser . . . proposes additional research to determine *which method of subtraction is the better.*"[10,11] (Italics mine.)

To date there has come to my attention only one published report which involved the idea Moser had in mind, and that investigation was conducted 35 years ago.

[8] Brownell and Moser, *op. cit.*, p. 159.

[9] Proposal submitted by Harold E. Moser in "Needed Research on Arithmetic." *The Teaching of Arithmetic.* Fiftieth Yearbook, Part II, National Society for the Study of Education. Chicago: University of Chicago Press, 1951. p. 289.

[10] Rheins and Rheins, *op. cit.*, p. 63.

[11] This does not appear to be the only instance of misinterpretation, or at least departure from conventional interpretation. For instance, on p. 66 the note with Table I states: "S.D. means Standard Deviation of the Mean, sometimes expressed as σ_M." It has been my personal impression that we properly refer to the standard deviation of a *distribution* of scores or the like, not to the standard deviation of a *single mean.* Likewise, the symbol in question σ_M, commonly is used to refer to the standard *error* of the mean; i.e., to the standard deviation of a distribution of sample means.

Winch[12] gathered data on the change from decomposition to equal additions and found that 12-year-old girls who attempted such a change subtracted as well as or better, after a few weeks of practice, than a comparable group which continued to use decomposition and did not change to equal additions.

However, the proposal has been, and is being investigated in more recent studies. The change from decomposition to equal additions was used as the basis for an unpublished personal study of interference in learning among college freshmen.[13]

In brief, it was found that students who changed from decomposition to equal additions (Group D-EA) experienced a marked, highly significant loss in computational skill (largely in terms of speed rather than accuracy) at the time of change in procedure. Through periodic practice this loss was overcome rather quickly, and students' efficiency with the newly learned procedure reached a level significantly above their level with the original decomposition procedure at the outset of the investigation.

Although those who changed from decomposition to equal additions constantly improved in their ability to subtract by the new method, their level of skill remained significantly below that of a comparable group of habitual users of decomposition who continued to apply and practice this procedure and did not change to equal additions (Group D). Furthermore, a third group who originally subtracted habitually by equal additions and continued to use and practice this method (Group EA) was consistently more skillful in compound subtraction than Group D, but not significantly so. However, Group EA's superiority over Group D-EA's was significant as well as consistent. By the end of the extended experimental period there was no indication that the status of these three groups would change materially with respect to each other, if at all, even with continued practice.

This is not the place to elaborate further upon the nature and findings of this investigation. It is recognized clearly, of course, that the conclusions reached for the sample of college freshmen are not necessarily valid for groups lower in the educational ladder, especially at the elementary level. However, in this connection it may be of interest to note that Mr. Gail Cosgrove, one of our doctoral candidates at the Boston University School of Education, has been investigating this same problem at the sixth-grade level. His data have been collected, but not analyzed and interpreted to date.

Yes, questions of a kind remain to be answered in relation to compound subtraction. The answers to these questions must be based on findings and conclusions from appropriate research. The comprehensive investigation by Brownell and Moser has done much to help us decide some of the important issues. At the same time, however, it has highlighted other issues which need further study, just as you have done in your Editor's Note.

In the interests of more effectively differentiated instruction in arithmetic, would it be advantageous for all children to begin with a common method of compound subtraction, decomposition, and then follow different paths—

(1) some continuing to use decomposition and never encountering equal additions as part of their systematic arithmetic instruction,

(2) some learning the nature of the equal additions procedure but continuing to use decomposition for efficient computation,

(3) some not only learning the nature of equal additions but also becoming proficient in its use to the extent that the original decomposition method is discarded,

etc., etc.? And if so, at what point(s) would these differentiations take place?

Future research on compound subtraction can be a challenging and helpful thing if we but make it such!

[12] W. H. Winch, " 'Equal Additions' versus 'Decomposition' in Teaching Subtraction: An Experimental Research." *Journal of Experimental Pedagogy* 5: 207-20 (1920); also 6: 261-70 (1921).

[13] J. Fred Weaver, "Skill in Subtraction: The Effect of Changing from the Method of Decomposition to the Method of Equal Additions." Unpublished Ed.D. dissertation. Baltimore: The Johns Hopkins University, 1952.

Results of General Mathematics Tests*

THEODORA NELSON
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WHAT CONCLUSIONS can be drawn from the analysis of the results of timed, competitive, objective-type, achievement tests in general mathematics on inter-high school contests? Although the immediate objective of the test has been to rank the contestants and to determine the winner, I believe that a study of the types of problems that were missed or omitted could yield something of significance to those of us interested in the teaching of general mathematics and arithmetic.

Before I attempt to answer the specific question that I have raised, it is necessary that we have some understanding of the nature of the Inter-High School Contests held annually at the Nebraska State Teachers College at Kearney. First, I will describe the total program and then I will tell about the test in general mathematics, in particular.

This year, 1955, is the twenty-fifth year that the Inter-High School Contests have been given at our college. They are a tradition now. Looking back at the records, it is interesting to notice the growth in both size and scope of this program. The first Inter-High School Contest was held in the spring of 1928 when six departments offered tests to contestants coming from nine high schools of the area served by the college. There were 45 entries. The peak year was 1953 when 124 schools made 2203 entries in all. I do not have the record of the number of contests each year but I know that 41 contests were offered in 1954 and 39 were offered in 1955.

For many years each participating school could send three entries for each contest. Now the number has been reduced to two because the size of the contests were becoming excessive and the initial screening process could easily be taken care of at the high schools prior to the contests at the college.

Inter-High Day is the Friday of the last week of March. Since the classrooms have to be available for the administration of the tests and the students of the college are needed to assist in the project, classes are dismissed for the day. It is a worthwhile experience for the student and it is gratifying to see the fine cooperation between the faculty and students. Frankly, we could not handle a program such as this in one day without their help.

Individual recognition to contestants winning first, second, and third places in each contest is made by the awarding of appropriate medals. A grand trophy is presented to the high school scoring the highest number of points. Three separate trophies are awarded to the high schools winning the highest number of points in each of three divisions according to their school enrollment as listed in that year's Nebraska Education Directory. In the event that any of these schools is also eligible to receive the grand trophy, the school of that division with the next highest score receives the award.

When I joined the faculty at Kearney nine years ago, I was the only full-time mathematics instructor on the staff. I was responsible for all mathematics to be given. Since contests had been offered in first-year algebra and plane geometry, I continued the policy. Later we added a test in second-year algebra. By 1951 another instructor was added to the staff and, because there was a demand for it, I decided to offer a test in general mathematics.

* This is a portion of a paper presented at the meeting of the National Council of Teachers of Mathematics at Bloomington, Indiana last August.

Since general mathematics is included in the program of studies of most high schools, this has been a very popular contest. The first year sixty-two persons took the test. In 1953 and 1954 there were 113 contestants in general mathematics.

I have those of my students who are preparing to teach and are juniors or seniors having majors or minors in mathematics in charge of the administration of the tests. This year we had the 105 contestants divided into three groups of thirty-five each. Each group was in a separate classroom. The student in charge in each room made all announcements and gave specific directions for the test. He had four assistants who distributed the tests, scratch paper, and other materials as well as helping supervise during the test. I make sure that each person knows exactly what he is to do and what his responsibilities are. These students do a fine job I know, and I have always been proud of the way they were able to handle the situation.

All of the tests are scheduled through an over-all committee of the faculty in charge of the general arrangements. All test results and student ranks must be available for the representatives of the participating schools by 4:30 P.M. that same day.

As a rule, standardized, commercially-produced tests are not used for these contests because such information does seem to get around. In order to make the competition as fair as possible, I set up my own tests. It follows the list of topics listed in the bulletin sent out announcing the Inter-High Day activities. The purpose of the test is to rank the contestants so that the first, second, and third place winners stand out distinctly. I admit that some of the problems are chosen because they require careful analysis but few, If any, are especially tricky. I believe that the test really accomplishes its purpose better if its length is also a factor in the competition. Whether any of you would agree that the tests used are good or not, I wouldn't say; however, I will say that they have clearly identified the winners.

I do not release copies of the test to anyone. There is a danger of someone using it without realizing its intent. I definitely would not recommend its use as an achievement test or as a final examination. If no one has advance copies, it does deter the amount of special grooming that is done. I do use the tests a second time once in a while.

Because more capable students usually have more ability to apply mathematics to a verbally-stated problem situation, I stress such problems in the test. In 1951 the test used was a completion-type objective test with a blank provided in the righthand margin for the answer. The checking was done manually using "strip" keys. Beginning in 1952, and since that time, a multiple choice test has been used so that it could be graded by machine to reduce the pressure of time in getting the results out on time.

Each year before I destroyed the answer sheets that the contestants used, I tabulated the number of times that the various problems were missed because they were wrong and also because they were omitted. Originally, my purpose in doing this was to have past performance records as a guide in making up a new test. Then the thought came to me that this data could be grouped and studied and possibly some worthwhile and helpful conclusions could be drawn. I was especially interested in general mathematics test results because the nature and content of this course is still not specifically defined and the information might be more significant than in a more traditional course. I am sure the test results can serve greater purposes than that of determining scores.

The tests used in 1951, 1952, and 1953 each consisted of sixty questions. The one for 1954 and 1955 had sixty-five items. I doubt that the last ten questions in the tests having sixty questions measure much of anything because of the length

of the test and the time limit imposed. Similarly, the last fifteen of the sixty-five questions may not have any significance in drawing of conclusions.

To facilitate the study of the results of these tests I have prepared charts, graphs, and tables. The table that follows shows the results accumulated during the past five years. The per cents followed by a check mark are based upon 113 fewer cases than the total number shown in the column labeled "Number Taking Tests" because the results for such items were not available for the year 1954. Readers will be particularly interested in the items which are easily identifiable as arithmetic. While these tests were given at the high school level, the results carry implications for teachers in all grades of the elementary school. Immediately one asks if results need be so poor and it is disturbing when one remembers that these tests were taken by selected high school students.

General Mathematics Test Results

TOPICS	NUMBER TAKING TESTS	% WRONG	% OMITTED	TOTAL % MISSED
FUNDAMENTAL OPERATIONS				
Integers:				
Add, Subtract	196	11.7	0.0	11.7
Long Division	280	12.0√	0.0√	15.0
Common Fractions:				
Add, Subtract	280	15.6√	0.0√	14.3
Multiply (computation)	280	39.5√	2.4√	41.8
(verbal)	280	29.9√	0.6√	30.0
Division (computation)	476	17.9√	1.1√	20.4
(verbal)	196	10.2	0.0	10.2
(verbal)	196	37.2	12.8	50.0
Decimal Fractions:				
Add	476	17.3√	0.3√	16.6
Multiply	196	9.7	0.0√	9.7
Multiply, Divide	280	34.1√	0.6√	35.3
Divide (verbal)	196	13.3	1.0	14.3
Denominate Numbers:				
Add (verbal)	476	9.4√	0.3√	11.1
Multiply, Subtract (verbal)	218	32.4√	50.5√	80.3
FRACTIONS = DECIMALS = PER CENT				
Fraction to Decimal	196	50.0	2.0	52.0
Fraction to Per Cent	476	5.0√	1.4√	6.5
Per Cent to Decimal	196	23.0	0.0	23.0
PER CENT				
Base × ____ % = Percentage	280	22.8√	4.8√	26.8
____ × Rate = Percentage	196	18.4	4.1	24.5
Verbal Problems:				
Baseball, % won	414	55.1√	11.9√	73.8
Per Cent (increase, decrease)	476	61.7√	3.0√	60.0
Per Cent (more than, less than)	280	53.9√	6.6√	57.5

TOPICS	NUMBER TAKING TESTS	% WRONG	% OMITTED	TOTAL % MISSED
Discount				
Find rate	414	29.5√	9.6√	45.7
Find marked price	280	61.8√	13.2√	75.0
Find selling price	196	13.3	0.5	13.8
Successive discounts	476	50.0√	5.8√	57.0
Simple Interest	196	33.6	10.2	43.8
Taxes	196	39.8	38.3	78.1
RATIO AND PROPORTION				
Finding height of flag pole by length of shadow	476	38.3√	13.2√	55.6
Finding one dimension of an enlargement	196	62.3	13.7	76.0
Distances on map	476	10.5√	1.9√	12.0
Solving a proportion	280	32.5√	28.7√	59.3
RATE: CHANGE UNITS				
Mi./hr. to ft./sec.	280	44.9√	32.9√	79.6
Mi./min. to mi./hr.	414	35.2√	26.2√	64.5
Mi./hr. to Km./min.	258	27.5	39.1	66.6
Mi./hr. to Km./hr.	196	51.6	15.3	66.9
FORMULAS				
Direct Substitution:				
$V = \pi r^2 h$	280	18.0√	10.2√	33.8
$V = (\frac{1}{3})\pi r^2 h$	196	37.2	16.6	54.1
$A = (\frac{1}{2})h(b+B)$	196	37.8	35.7	73.6
Using Formulas:				
Given—l, w, h; 200 cu. ft./pupil; Find—Number of pupils	196	9.2	4.6	13.8
Cost of cellar	280	64.7√	7.3√	73.5
Rectangular solid—*l*, *w*, capacity; Find—depth	476	44.7√	22.0√	65.6
Rectangle—perimeter, *w*; Find—Area	476	58.7√	19.6√	81.8
Circumference of Circle	476	45.2√	16.8√	67.8
Surface of Cube	280	54.5√	15.6√	73.9
Surface of Cube to Volume	196	43.8	42.8	85.7
MISCELLANEOUS PROBLEMS				
Averages	476	23.4√	0.0√	20.6
Rounding off	476	19.8√	2.5√	24.6
Board Feet	476	46.2√	39.6√	85.2
Shares	218	32.4√	56.1√	92.2
Travelers Checques	196	59.2	12.7	71.9
Wages	196	29.1	1.0	30.1
Bus Tokens	196	1.5	0.0	1.5
——bu. in 3 Tons	280	20.4√	3.0√	24.3

TOPICS	NUMBER TAKING TESTS	% WRONG	% OMITTED	TOTAL % MISSED
STATISTICAL GRAPHS				
Line graph—Temperature during a day:				
When did temp. rise most?	476	17.1√	22.8√	47.6
When did temp. rise least?	476	55.6√	20.9√	73.0
When did temp. fall most?	476	32.0√	23.1√	55.8
SIMPLE ALGEBRA				
Add, Subtract (combined)	476	58.4√	27.5√	85.2
Subtract (polynominals)	280	53.8√	19.8√	75.4
Multiply (binomial times monomial)	476	38.0√	31.6√	69.6
$(-2x^2y^3)^2$	196	35.2	58.8	94.0
Fractions:				
Add	280	49.6√	37.7√	87.2
Subtract	280	59.8√	33.5√	93.2
Divide	280	40.1√	41.8√	81.4
Simplify Radical	476	52.1√	41.9√	94.3
Special Products:				
$(a+b)^2$	476	51.6√	39.7√	89.7
$(a+b)\ (a-b)$	280	44.9√	23.4√	63.6
Factoring:				
Common Factor	280	44.3√	34.1√	78.5
(a^2-b^2)	196	29.6	60.3	89.8
$(x+b)\ (x+c)$	476	39.4√	49.6√	87.1
Evaluating Polynomial in x:	280	53.8√	22.8√	76.8
Equations:				
Linear, solve for x	476	39.4√	42.4√	80.3
Linear, with fractions	476	41.3√	24.8√	71.8
Simultaneous, two unknowns				
$x=$ _____	476	38.8√	45.5√	80.0
$y=$ _____	476	41.3√	32.6√	71.9
Verbal Problems	280	21.0√	12.6√	36.1
Algebraic Symbolism	476	31.4√	29.2√	56.4
Graphs:				
Coordinates of Points	476	25.6√	70.8√	94.5
Equations of Lines	280	40.1√	56.8√	97.1
Points on a Line				
$x=$ _____	476	49.6√	36.2√	86.6
$y=$ _____	476	46.5√	33.3√	82.3
INTUITIVE GEOMETRY				
Right Angle = 90°	476	5.0√	4.7√	12.8
Isosceles Triangle—definition	280	25.1√	11.4√	45.4
Angle of Equilateral Triangle = 60°	280	23.6√	15.6√	45.4

TOPICS	NUMBER TAKING TESTS	% WRONG	% OMITTED	TOTAL % MISSED
Sum of Acute Angles of Right Triangle	196	17.8	8.2	26.0
Rectangle—definition	196	8.2	15.8	24.0
Trapezoid—definition	280	21.6√	25.8√	47.5
Pythagorean Relations				
Distance Saved—diagonal	280	41.9√	29.3√	72.4
Distance (homeplate, pitcher) to Second Base	476	63.0√	31.4√	94.5

√ This per cent does not include test results for 1954 and is, therefore, a per cent based on 113 less students than the figure given in the column *"Number Taking Tests."*

In view of the facts that I have presented, I believe that we may draw a few conclusions. Although we recognize that general mathematics does have a place in the program of general education, this analysis indicates certain areas where weaknesses are most evident. These are as follows:

1. Arithmetical computations
2. Verbal problems in applied mathematics.
3. Problems in applications of per cent.
4. Evaluation of and use of simple formulas.
5. Interpretation of graphic representation of data.
6. All phases of simple algebra that were tested.

Since the participants in these contests were primarily those who could be considered as better than average students, the actual record of performance of all students of general mathematics would no doubt show even a greater degree of weakness than that which this research has indicated. The implications deserve serious consideration.

What should be done? First, a study of the effectiveness of the general mathematics program should be made continually. Ways of improving instruction where it is needed should be carefully considered. Possibly a revision of the program in arithmetic for the elementary school is in order, so that general mathematics will not have to devote such a great part of its content to remedial instruction. There is no single, easy solution, I am sure, but we cannot solve any problem by either refusing to admit its existence or by taking no action whatever.

EDITOR'S NOTE. When the editor heard Miss Nelson's presentation last summer he was distressed by the per cents of pupils who were not performing well in arithmetic in the high school. Many of the exercises were basically elementary school arithmetic. Before one becomes too discouraged by Miss Nelson's findings he should know more about the data. For example: (a) are pupils in general mathematics as represented in this sample of lesser ability and interest in mathematics than other pupils?; (b) is the foundation work of these pupils in their elementary school experience on a par with the country as a whole?; and (c) can these pupils truly be regarded as "selected" in a real sense or perhaps small high schools may have merely named someone so as to be represented? People who have seen Miss Nelson's test items do not regard them as "tricky" although a few of them are a little involved. Since arithmetic is the most useful branch of mathematics for the general citizen, the one who probably studies general mathematics in the high school, it behooves all of us working at various levels to obtain better results.

Division for First Graders?

DOROTHY S. AMBROSIUS
First Grade, Capron, Illinois

IN OUR FIRST GRADE we take advantage of every possible arithmetic experience that presents itself in class. Very early in the year the children discovered why they counted; to find out "how many." As simple as that. And they have gleefully counted everything ever since. Then came groupings, and again we used the many materials available in every classroom, including ourselves. The children particularly loved to work with some cork discs that I retrieved from a small manufacturer just before he threw them in the scrap barrel. These are light weight and don't clatter if they fall to the floor.

As the youngsters became familiar with separating things into groups and then counting to find out how many all together, or with finding how many were left if they took a smaller group from a larger group, I began casting about for something new at which the children could succeed, but which would challenge them. I had picked up a box of wholesome looking miniature cookies on the way to school with the thought that these might add an extra incentive just in case an inspiration on my part, and a golden opportunity on the children's part, should strike simultaneously.

We had been working out groupings of nine in the class the day before and had many illustrations, made by the children, on the bulletin board. These were in groups of two, such as 5 and 4, 6 and 3, 7 and 2, etc. On this eventful morning, for "Share and Tell" time, cute little round-faced Ann, proudly displayed a picture, in full color, that she had cut from a magazine, showing nine oranges floating across a full page in groups of three. She said "There are just nine; I counted them." Somehow I knew that here was my "golden opportunity" and that I must grasp it. The rest simply unfolded with the children's help, and my First Graders were getting their first taste of division.

I asked the children to count Ann's oranges with her, and then asked them to look at our groupings on the bulletin board. I asked "Are there any just like the one Ann has brought us?" Several of them spotted the three and six grouping, and I showed them how we could easily make that into a three-three-three grouping. Then I asked them how many groups of three there were in nine. This baffled them and most of them said "nine". I pointed to Ann's oranges again and said "Yes, there are nine oranges all together, but now let's look at the groups." I drew a circle around each group of three, and said, "Now, let's count the groups". I framed each group of three with my hands as we counted them, "one, two, three." I said "Yes, there are three three's in nine."

Now the children were anxious to get on with "Share and Tell Time" so it wasn't until afternoon that I produced my box of cookies. Only a First Grade Teacher knows what excitement and speculation followed. After things calmed down I counted out eight cookies with their help. I explained that I wanted to give these eight cookies to them, but since they were so small I would give two to each child, but, how many children would I call to my desk? We'd have to find out how many two's there were in eight. I suggested that they take eight of their little cork discs out of their desks and pretend they were the cookies. This was quickly accomplished but only Brad made a significant move. He started to pick up two discs at a time but didn't seem quite sure of what

to do with them. So I referred to Ann's oranges again with the circles around the groups. "Let's pretend that Ann wants to share her oranges and has decided to give three oranges each to some of her friends. How many groups of three did we find in nine? Now, divide your 'pretend' cookies into groups of two each and see how many groups of two you can find in eight."

I could see that Brad was mentally drawing circles around his groups and many of the other children were manipulating their discs into groups of two. After most of the children had made the right groupings I called on Brad to tell about his. "I could give cookies to this many" he said, pointing to the groups. I had him count the groups, then allowed him to divide the real cookies into groups and pass them.

The same thing was done with six, ten, four, and eight several times until all had cookies, and all could easily divide and count their groupings. Each time the children found the proper number of groups I would say "Yes, there are three 2's, or five 2's" (or whatever) in the group they were working with.

I'm sure these children will find division and multiplication fun when they come to them, just as all arithmetic should be fun.

EDITOR'S NOTE. The pupils in the first grade with Mrs. Ambrosius had a real and thrilling experience in the sharing or dividing of cookies. Note that this was visual and oral, it started the concept of division. This type of initial learning will enable many pupils to continue their discovery. Some of her pupils have probably already encountered the problem of sharing or dividing a number such as 15 into groups of 2 each. In all such early learning experiences the teacher should help the pupils to think but should not furnish the answers. Yes, arithmetic can be fun and at the same time very fruitful. What similar experiences have other teachers to report?

Bizz-Buzz Game in Arithmetic

GEORGE JANICKI
Elm School, Elmwood Park, Illinois

THE FOLLOWING GAME can be played in a class of the 5th, 6th, or 7th grade to test their knowledge of the multiplication tables.

Select some multiplication table to be coded and called BIZZ; another to be coded as BUZZ. Be sure BUZZ is not a multiple of BIZZ.

I selected the table of 3's for BIZZ and the 7's for BUZZ.

Then I proceed to ask the group to count around the room, one at a time, substituting the proper code for any multiple of 3 or of 7.

It is surprising how inaccurate some of the brighter students can be under such mental stress and how accurate the slower ones can be.

To add fun to the game, every time a mistake is made in the counting process, we start all over again with 1.

In case you wish to have a written lesson on this game, have the students or class write down the numbers from 1 to 37 using these 2 coded words.

This game can be changed to have other multiplication tables used for BIZZ and BUZZ such as the 5's and the 9's.

I found this quite stimulating with younger groups and they are eager to try to recite the cycle perfectly just once!

CORRECT RESPONSES:

1, 2, BIZZ, 4, 5, BIZZ, BUZZ, 8, BIZZ, 10, 11, BIZZ, 13, BUZZ, BIZZ, 16, 17, BIZZ, 19, 20, BIZZ-BUZZ, 22, 23, BIZZ, 25, 26, BIZZ, BUZZ, 29, BIZZ, 31, 32, BIZZ-BIZZ, 34, BUZZ, BIZZ, 37.

A Meaningful Approach to Cancellation

JOHN A. PEOPLES
Froebel School, Gary, Indiana

MUCH PROGRESS has been made by arithmetic teachers and textbook writers in developing arithmetic along meaningful lines, but there still are phases of the subject for which a meaningful approach has not been developed. A very useful concept, for which a complete rationalization has not been incorporated in current textbooks, is the one of "cancellation,"—or in more meaningful terms, "reducing before multiplying." This fraction concept, for the sake of demonstration, is usually presented in two parts: "vertical", as in

$$\frac{\cancel{12}^{3}}{\cancel{16}_{4}} \times \frac{\cancel{5}^{1}}{\cancel{15}_{2}} = \frac{3}{8}$$

and "diagonal" as in

$$\frac{\cancel{2}^{1}}{\cancel{3}_{1}} \times \frac{\cancel{3}^{1}}{\cancel{16}_{8}} = \frac{3}{8}.$$

The vertical can easily be explained in terms of reduction of common fractions, but the diagonal is usually explained on a "take my word for it" or "the explanation is on too high a level" basis, leaving the student to apply it perfunctorily, with no feeling for the powerful generalization on which the idea is really predicated.

Certainly, all arithmetic teachers are familiar with the commutative law of multiplication, which, of course, is taught in less sophisticated phraseology on the lower intermediate levels. It is upon this simple but important law, which says, in more general terms, that $2\times3=3\times2=6$, that cancellation in multiplication of fractions can be completely rationalized and based. The following illustration will show how students with a knowledge of simple commutativity can easily be shown the intricacies of cancellation.

Let us suppose that a teacher, having demonstrated "vertical" cancellation in multiplying a fraction by a fraction, presents to the class the example $15/16\times 3/10$. Having no knowledge of diagonal reductions, the pupils get as an answer the product of the numerators over the product of the denominators, specifically, 45/160. Following the rule of simplification, the pupils attempt to reduce this fraction. Although, a few might succeed, many are awed by such large terms. This is the opportune time for the teacher to suggest that the class experiment to see if there is some way to avoid such large terms in the product. As an initial step, the teacher should lead the pupils to discover that the product will be unchanged if the numerators or the denominators are interchanged. In our example, that would mean, $15/16\times3/10=3/16\times15/10=45/60$. The pupils should then observe, or be led to observe, that the result obtained from the interchanging contains as a factor, 15/10, a vertically reducible fraction. Then they should reason, or be led to reason, that if all of the products are the same, why couldn't they have reduced 15/10 in the original example? Now this is the climactic point of the learning situation; for with—and very probably without—a little prompting by the teacher, the pupils will discover a very important fact: that in a multiplication example, each fraction which makes up the product can be seen as composed of a numerator and a denominator, either of which may or may not be above or below the other. Thus, in our example, there are four possible fractions to consider for reduction: 15/16, 15/10, 3/16, and 3/10. And it is important for the pupils to realize

that these fractions may be and should be formed mentally, using vertical and diagonal reductions, rather than literally interchanging the numerators and/or the denominators to make possible all vertical reduction.

The foregoing describes a learning situation in which this writer has many times played the role of the teacher. Having played this role, the writer feels that such a situation not only contributes to the meaningfulness of arithmetic, but it also helps to dispense with the notion that mathematics is inherently abstruse.

EDITOR'S NOTE. Mr. Peoples presents his way of making cancellation meaningful and understandable to his pupils. Note how he expects them to reason and to find a way to make the work simpler. This is very different from the old "I'll show you how, now you do it" method. The current revolution or evolution in teaching arithmetic is one of method of guiding pupil learning. Let us have more of these approaches in our schools.

Five Ways to Improve Arithmetic Instruction

MARGARET SPEARS

Congress Park School, La Grange, Illinois

1) Let us build an extensive mathematical vocabulary at each grade level.

   Require students to learn the meaning of QUOTIENT, for example. Help the child to firmly place that word in his vocabulary by daily questions such as, "What is the quotient in Problem 2?"

2) Let us teach our students to estimate measurements with a high degree of accuracy.

   Illustrate ONE FOOT, for example, in a variety of settings so that the student carries a mental picture of approximately twelve inches. It is said that when we can measure that which we are speaking about and express it in numbers, we KNOW a great deal about it.

3) Let us present something new and challenging in mathematics each day.

   The student becomes inattentive who thinks another class period is to be devoted only to adding fractions. In a brief interval, ask him to try to solve the puzzle on the board; to fill in the blanks for the Magic Square on Page 15 (of the text); to try to solve the cross-number puzzle. All of us realize, however, that the understanding of mathematics can't be transmitted by painless entertainment alone. We should use this device sparingly.

4) Let us teach our students to solve verbal problems with an without such mediums as chalk and pencil.

   A brief period devoted to mental arithmetic each day is valuable. The class discussion should include meaningful drill materials. While some of the slower students use a pencil, we should expect the more alert students to work independently without a pencil. This is one way in which the teacher can regulate the volume of work which can be produced by a mentally varied group.

5) Let us help our students to develop their maximum degree of accuracy and speed when solving problems by grading meticulously each lesson which they prepare.

   We should demand that all papers be neat and well organized. To check a problem as merely incorrect is of little value. It is circling the PART of the problem which is incorrect that pays dividends when the student makes his correction. Mathematics papers more than twenty-four hours of age are of questionable value when returned to the class. It is this constant and careful checking by the teacher which helps to bring about the best efforts on the part of the students in the Queen of the Sciences.

Note on Philosophy of Teaching Arithmetic

HOWARD F. FEHR
Teachers College, Columbia University

MORE AND MORE the only services which human beings can offer to society and which society will need will be intellectual. Just as in the last 100 years mechanical skill superseded and to a great extent outmoded manual labor, in the next few years the automatic machine will supersede and to a great extent outmode mechanical skill (not entirely but mechanical skill will be cheap, comparatively to brain power). The age of automatons, for their development, construction, and maintenance, demands from society greater brain power.

Hence it depends upon the schools to develop brain power, not only top notch brains, but the brain power of each and every individual to the capacity that he has such power. The power to think, to solve problems, and to apply knowledge to life situations, although not to the same extent, is present in all but very subnormal persons. The schools must develop this power along with a moral code for the exercise of brain power.

The life adjustment programs, and core programs in almost all their practice have failed to recognize this essential necessity of life in the culture that now is and is becoming. They have taught conformity (without recognizing that they are so doing) instead of self-exercise of an individual's thought (individual excellence). They have taught problem solving as trial and error and patch work of an already existing state of affairs, instead of the procedure of applying past knowledge to new situations. They have overlooked and passed by the great value of learning concepts, generalization and relations as a structure or organization in the various areas of knowledge, before one can use these areas intelligently in the solution of new puzzling problematic situations.

Arithmetic, as one of these areas of learning, offers the best type of intellectual development for our modern culture, only if it is taught with the aim of organization of concepts and relations of number through understanding, meaning, and application, and not by rote manipulation. This is true, perhaps not to as great an extent, but nevertheless true, in all the other great areas of learning, e.g. language, history, the sciences, including social sciences. It is possible also in the arts, but these areas of human endeavor have other values to humans as well as the intellectual.

We must educate children (all children) so that as they mature to adults they think critically and then act responsibly. Every subject we teach in school must be taught, from the very start, for its contribution to developing brain power, not merely memory and facts alone. A student must learn by thinking, by abstracting from experience, by organizing and structuring what he has learned so as to facilitate his ability for problem solving. Thus we gain our knowledge and facts, not as word sentences and manipulations, which are learned by rote and repeated when asked for, but through organization of experiences in problem situations. The solution of any problem usually gives us another concept, or precedure which becomes new knowledge to be used in solving new problems. Thus thinking is learning and learning is thinking. Meaningless statements or manipulations, in the ordinary sense, are not to be construed as learning. (There are meaningless statements in science, which however, are meaningful in the system and method in which they are used.)

Will children learn arithmetic in this manner? They will. They will because most children are eager to satisfy external conditions to get esteem, recognition, love, status. They will do their study of mathematics not only because of their natural curiosity but also because they believe, by the way the teacher behaves, that she, the teacher, gains delight in her knowledge of mathematics. To be like the teacher is to gain the teacher's respect or consideration.

Thus arithmetic teachers should reflect a genuine love of their subject and show genuine approval to children who gain the same love of mathematics. The brain power thus developed in arithmetic and all the other areas of human knowledge will pay dividends beyond any expectation.

Washington and February

Modern calendars list President Washington's birthday as February 22 and the year of his birth is usually given as 1732. However there is a good deal of doubt whether the date on which he was born was so recorded. Was it back in 1752 that eleven days were dropped out of the year and the beginning of the year changed from April to January? What did these changes do our first president's birthdate? It is very probable that he was born on February 11 and the year was 1731. Imagine the confusion that must have existed when the calendar was changed. Pupils can learn a good deal about the recording of time by starting with a challenge such as checking the actual date of the day on which George Washington was born.

The Annual Meeting

The annual meeting of the National Council of Teachers of Mathematics will be held in Milwaukee at the time of the spring meeting April 12–14, 1956 for the transaction of official business. Members of the Council will receive official programs giving time and date.

Preview—Milwaukee Meeting

Arithmetic Sections

Thursday—April 12, 1956

1:15–1:45 P.M. DEMONSTRATION LESSON

Presiding: Francis G. Lankford, Jr., Vice-President, National Council of Teachers of Mathematics

Teacher: Reino M. Takala, Hinsdale Township High School, Hinsdale, Illinois

2:00–3:30 P.M. ELEMENTARY SCHOOL SECTION

Presiding: Ann Peters, State Teachers College, Keene, New Hampshire

2:00–2:40 P.M. *Curing Arithmetic Ills.* Lesta Hoel, Supervisor of Mathematics, Portland, Oregon

2:40–3:20 P.M. *Number Concepts Held by Pre-School Children.* George Hollister, College of Education, University of Wyoming, Laramie, Wyoming

3:20–3:30 P.M. Discussion

3:45–5:15 P.M. Elementary School Laboratory 1

Leader: Lucille Houston, Public Schools, Racine, Wisconsin

Friday—April 13, 1956

10:00–10:45 A.M. *Developing Creative Thinking in Arithmetic.* Calvin Reed, College of Education, University of Nebraska, Lincoln, Nebraska

10:45–11:30 A.M. *A Meaningful Approach to the Teaching of Common Fractions.* Irwin K. Feinstein, University of Illinois, Chicago Branch

11:30–11:45 A.M. Discussion

2:00–3:30 P.M. Evaluation Section

Presiding: Howard Fehr, Columbia University, New York, New York

General Theme: *Developing A Test in Mathematics—Grades 4 through 14*

Lenore John, University of Chicago Laboratory School, Grades 4 through 6

Max Lobel, Southside High School, Newark, New Jersey, Grades 7 through 8

Max Beberman, University of Illinois, Urbana, Illinois, Grades 10 through 12

Phillip Jones, University of Michigan, Ann Arbor, Michigan, Grades 12 through 14

Robert Kalin, Educational Testing Service, Princeton, New Jersey, Statistical Considerations

Report of the Nominating Committee

The Committee on Nominations and Elections presents below the names of persons nominated for offices to be filled in the election of 1956. The term of office for the President and the Vice-Presidents is two years. Three directors are to be elected for terms of three years.

Attention is called to the following provisions of the Constitution:

"Nominations shall be made so that there shall be not more than one director elected from each state, and that there shall be one director, and not more than two, elected from each area." For a map of the regions as now constituted, members may consult THE MATHEMATICS TEACHER for October, 1955, page 442. Under the regulation quoted above it is necessary to insure the election of at least one director from the North Central Region. To avoid a situation in which nomination would be equivalent to election, the Committee has nominated two candidates from the North Central Region and has adopted the following rule for determining who shall be declared elected as directors:

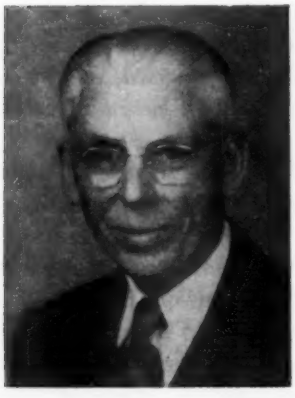
The three candidates receiving the largest number of votes will be declared elected, provided at least one of them is a candidate from the North Central Region; otherwise, the two candidates receiving the largest number of votes will be declared elected, and of the two candidates from the North Central Region, the one who receives the larger number of votes will also be declared elected.

Ballots will be mailed on or before February 25, 1956 from the Washington office to members of record as of that date. Ballots returned and postmarked not later than March 25, 1956 will be counted, but balloting will be officially closed as of March 25, 1956.

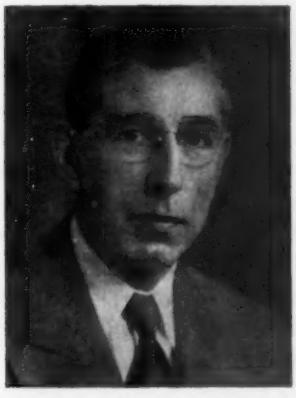
The Committee wishes to thank all those who suggested persons for consideration and urges all members to vote.

M. L. HARTUNG, *Chairman*
MILTON BECKMANN
CLIFFORD BELL
IDA MAE BERNHARD
F. G. LANKFORD, JR.
JOHN MAYOR
ROLLAND R. SMITH
BEN A. SUELTZ
F. LYNWOOD WREN

NOMINEES FOR PRESIDENT



H. GLENN AYRE



HOWARD FRANKLIN FEHR

H. Glenn Ayre

Professor of Mathematics, Head of Department of Mathematics, and Director of General College Division, Western Illinois State College, Macomb, Illinois.

Ed.B., Southern Illinois University; S.M., University of Michigan; Ph.D., Peabody College for Teachers.

Instructor in rural schools, Marion County, Illinois; High School, Carterville, Illinois; High School, Benton, Illinois; High School, Waukegan, Illinois; Supervisor of Student Teaching in Mathematics, Professor of Mathematics and Head of Department, Western Illinois State College, Macomb, Illinois.

Member: NCTM and CASMT since 1924; AAAS; NEA; Illinois Education Association; MAA; Phi Delta Kappa; and other educational societies. Listed in *American Men of Science, Who's Who in Education, Who's Who in the Midwest.*

Activities in NCTM: Vice-President, 1953–55; Chairman, Committee on Affiliated Groups, 1954–56; Program Chairman, Summer Meeting in Seattle, 1954: Editor, Handbook Committee, 1954; Editor, Affiliated Groups Newsletter, 1954; Member, Executive Committee, 1954; Chairman, Committee on Free and Inexpensive Materials, 1953; Member, Algebra Committee for *Seventeenth Yearbook;* Secretary of Symposium on Teacher Education in Mathematics, University of Wisconsin, 1952; Publicity Committee, 1952; speaker and discussion leader for many NCTM programs.

Other Activities: President, Illinois Council of Teachers of Mathematics, 1955–56; Member of Executive Council, 1948–53; Vice-President and Chairman, Illinois Section MAA, 1951–53; Member, Joint Committee of Illinois Section MAA and NCTM to Study Teacher Training in Mathematics; Member, Committee on Tests for ICTM and Illinois Curriculum Project; Chairman, Mathematics Section and Junior College Section CASMT, 1941, 1947; speaker and discussion leader for numerous institutes and workshops in mathematics education.

Publications: "An Analysis of Individual Differences in Plane Geometry," "An Analysis of the Performance of College Freshmen on Arithmetic," *Basic Mathematical Analysis;* numerous articles in professional journals; Co-author of *A First Course in Coordinate Geometry,* 1956.

Howard F. Fehr

Professor of Mathematics and Head of the Department of Teaching of Mathematics, Teachers College, Columbia University, New York, New York.

B.A., A.M., Lehigh University; Ph.D., Columbia University.

Instructor in Mathematics, High School, Bethlehem, Pennsylvania; High School for Boys, Reading, Pennsylvania; South Side High School, Newark, New Jersey; Instructor and Professor of Mathematics, State Teachers College, Montclair, New Jersey, 1934–48; Teachers College, Columbia University, 1948– . Also Instructor at Newark College of Engineering and Rutgers College.

Member: NCTM; CASMT; MAA; AAAS; American Educational Research Association; AMS; British Mathematics Association; Société Belge de Professeurs de Mathematiques; Association des Professeurs de Mathematiques de France; NEA; Association of Mathematics Teachers of New Jersey; Association of Mathematics Teachers of New York State; and other educational societies. Listed in *Who's Who in America, American Men of Science, Who's Who in American Education.*

Activities in NCTM: Past President of the Association of Mathematics Teachers of New Jersey and Association of New Jersey State Teachers Colleges (3 terms); Member, Board of Directors, 1953–56; Representative to International Congress of Mathematicians at Amsterdam, 1954.

Publications: *A Study of the Number Concept of Secondary School Mathematics;*

Secondary Mathematics, A Functional Approach for Teachers; Co-author of *Senior Mathematics for High Schools; Algebra, Course 1; Algebra, Course 2; Arithmetic at Work;* numerous articles in *Teachers College Record,* THE MATHEMATICS TEACHER, *School Science and Mathematics,* and other educational journals.

NOMINEES FOR VICE-PRESIDENT—SENIOR HIGH SCHOOL LEVEL

DONOVAN A. JOHNSON

ELIZABETH JEAN ROUDEBUSH

Donovan A. Johnson

Chairman of Mathematics Department, University of Minnesota High School and Associate Professor of Education.

B.S., M.A., Ph.D., University of Minnesota.

Science Teacher, Stillwater, Minnesota; Mathematics Teacher, Sheboygan, Wisconsin; Office Manager, Social Security Board, Bloomington, Illinois; Electric Theory and Mathematics Instructor, Naval Training School, University of Minnesota.

Member: NCTM; Phi Delta Kappa; National Education Association; Minnesota Education Association; Mathematics Association of America; Central Association of Science and Mathematics Teachers; American Educational Research Association.

Activities: Member, Board of Directors, NCTM, 1950–53; Chairman, Minnesota State Mathematics Curriculum Committee; President, Mathematics Section, Minnesota Education Association; member of several professional committees and speaker at numerous mathematics conferences.

Publications: Co-author of *The World of Numbers, Grades 4–7, Workbooks;* Editor of *Minnesota Mathematics Newsletter;* Co-editor of "Aids to Teaching," THE MATHEMATICS TEACHER; numerous articles in THE MATHEMATICS TEACHER, *School Science and Mathematics,* and *Journal of Experimental Education.*

Elizabeth Jean Roudebush

Director of Mathematics from Kindergarten through Grade Twelve for Seattle Public Schools, Seattle, Washington.

Graduate of State College of Washington, Pullman, Washington; A.M., Teachers College, Columbia University; summer sessions at University of Washington, University of California at Los Angeles, and University of Southern California.

Teacher, Mathematics, Roosevelt High School, Seattle, Washington; Mathematics Department Head, Edison Technical School, Seattle, Washington; Director

of Mathematics, Seattle, 1949– . During World War II served in WAVES as Women's Reserve Representative at U. S. Naval Hospital in Chelsea, Mass.

Member: NCTM; ASCD; NEA; Washington Education Association (Past President of local group affiliated with WEA and NEA); Delta Kappa Gamma (Past Vice-President of local chapter); Pi Lambda Theta (Past President of local alumnae chapter).

Activities in NCTM: Member, Board of Directors, 1953–56; Regional Representative of Western Region of Affiliated Groups; Chairman of Place of Meetings Committee; Co-chairman in Charge of Local Arrangements for 1954 Summer Meeting; Section Speaker at 1953 Christmas Meeting.

Other Activities: helped organize Puget Sound Council of Teachers of Mathematics; helped organize Washington State Mathematics Council.

Publications: *Laboratory Geometry;* "An Arithmetic Bulletin for Parents," THE MATHEMATICS TEACHER, May, 1951.

NOMINEES FOR VICE-PRESIDENT—ELEMENTARY SCHOOL LEVEL

MARGUERITE BRYDEGAARD

LAURA K. EADS

Marguerite Brydegaard

Associate Professor of Education, San Diego State College.

A.B., San Diego State College; M.A. (and advanced graduate study), The Claremont Graduate School; travel in Europe to study art and to investigate methods for teaching mathematics in the elementary school.

On Editorial Board of the Association for Childhood Education International, 1954–56; Director of Summer Conferences on Teaching of Mathematics, S.D.S.C.; led many workshops and presented reports and studies to local, state, and national groups of educators; presented papers at several NCTM meetings; presented paper at University of Wisconsin Mathematics Conference, 1953; worked on elementary level testing at Educational Testing Service Workshop, 1955.

Member: NCTM; Kappa Delta Pi; Pi Lambda Theta; ACEI; California Mathematics Council.

Activities in NCTM: Member, NCTM Committee on Supplementary Publications, 1955– .

Publications: articles include "Creative Teaching Points the Way," first issue, *Arithmetic Teacher;* article in *The Bulletin* (National Association of Secondary School Principals), 1954; Co-author of *Building Mathematical Concepts in the Elementary School,* 1952.

Laura K. Eads

Specialist in Arithmetic for the Bureau of Curriculum Research, New York City.

B.S., University of Buffalo; M.A., Ph.D., Teachers College, Columbia University.

Taught all elementary grades in both urban and rural schools; formerly Psychologist, Friends Seminary, New York City; responsible for planning and organizing experimental research, for preparing curriculum materials, and for general supervision of various aspects of the developmental mathematics program for the city schools; pioneered in the production of educational sound pictures with Encyclopaedia Britannica Films and Young America Films.

NOMINEES FOR THE BOARD OF DIRECTORS

LESTA HOEL

PHILLIP S. JONES

HOUSTON T. KARNES

PHILIP PEAK

H. VERNON PRICE

ANNIE JOHN WILLIAMS

Lesta Hoel

Western Region

Supervisor of Mathematics (Grades 1-12), Portland Public Schools, Portland, Oregon.

B.S., Whitman College; M.A., University of Oregon; attended summer sessions at University of California, University of Colorado, University of Washington, and Duke University Mathematics Institute.

Elementary and high school mathematics teacher; Head of Mathematics

Department, Grant High School, Portland, Oregon; Supervisor of Mathematics, Portland Public Schools, 1940– ; Instructor in the General Extension Division of the Oregon State System of Higher Education.

Member: NCTM (since 1927); Mathematical Association of America; NEA; ASCD; ACEI; Phi Beta Kappa; Oregon Council of Teachers of Mathematics (Past President).

Activities in NCTM: Local Chairman for Summer Meeting, Portland, 1936; Exhibit Committee for Summer Meeting, Seattle, 1954; Member, Nominating Committee, 1953.

Other Activities: Local Chairman for meeting in Portland in connection with NEA, 1956; Chairman of current committee preparing a State Secondary Mathematics Guide for Oregon; appearance on convention programs.

Publications: "An Experiment in Clinical Procedures for Arithmetic," *Twenty-Second Yearbook*, National Council of Teachers of Mathematics; "What Constitutes Remedial Work in Arithmetic?" THE MATHEMATICS TEACHER, January, 1950; "Good Teachers Cannot Be Bought," *The Nation's Schools*, February, 1946.

Phillip S. Jones

North Central Region

Associate Professor of Mathematics and of the Teaching of Mathematics, University of Michigan, Ann Arbor, Michigan.

A.B., M.A., Ph.D., Univ. of Michigan.

Teacher, Jackson High School, Adult Evening School and Junior College, Jackson, Michigan, 1934–37; Instructor, Edison Institute of Technology, Dearborn, Michigan, 1937–43; Special Instructor, A.S.T.P., V-12 Reserve Officers Naval Architecture Program, E.S.M.W.T., University of Michigan, Ann Arbor, Michigan, 1943–44; Instructor, University School, Ohio State University, Columbus, Ohio, 1944–45; Teaching Fellow to Associate Professor of Mathematics and Assistant to Associate Professor of Education, University of Michigan, 1945– .

Member: Delta Sigma Pi (professional commercial fraternity); Phi Rho Pi (forensic); Phi Kappa Sigma (forensic); Phi Kappa Phi; Sigma Xi; National Council of Teachers of Mathematics (Member, Board of Directors); Central Association of Science and Mathematics Teachers; American Association for the Advancement of Science (Fellow); History of Science Society; American Mathematical Society; Mathematical Association of America (Member, Board of Governors); A.A.U.P.

Activities in NCTM: Member, Board of Directors; Committee on the Official Journal; Committee on Small Publications; Committee on Relations with Science and Industry; Editor of a yearbook in progress; Editor of "Mathematical Miscellanea" and "Historically Speaking" Departments of THE MATHEMATICS TEACHER.

Publications: *Understanding Numbers*, a pamphlet accompanying a series of mathematical television programs; articles in THE MATHEMATICS TEACHER, *School Science and Mathematics*, *Scripta Mathematica*, *American Mathematical Monthly*, *Eighteenth and Twenty-Second Yearbooks of the NCTM*, *Chicago Schools Journal*.

Houston T. Karnes

Southwestern Region

Professor of Mathematics, Louisiana State University, Baton Rouge, Louisiana.

A.B., A.M., Vanderbilt University; Ph.D., Peabody College for Teachers; summer sessions University of Wisconsin and University of Michigan.

Professor of Mathematics and Biology, Northwestern Junior College, Orange City, Iowa, 1929–35; Professor of Mathematics and Dean of Men, Harding College, Searcy, Arkansas, 1935–36; Teacher of Mathematics and Department Head, high schools, Nashville, Tennessee, 1936–

38; Assistant in Mathematics, Louisiana State University, 1938–40, Instructor, 1940–42, Assistant Professor, 1942–45, Associate Professor, 1945–53, Professor, 1953– ; Dean of Men, Louisiana State University during war years; in the summers, Visiting Professor in the College of Education, Louisiana State University, conducting courses in teacher training.

Member: NCTM; MAA; American Mathematical Society; National Education Association; Louisiana Education Association; American Association of University Professors; Pi Mu Epsilon (Associate Editor of Pi Mu Epsilon Journal); Kappa Mu Epsilon; Phi Delta Kappa; Kappa Delta Pi; Omicron Delta Kappa; Phi Kappa Phi; Board of Trustees, Harding College; Louisiana-Mississippi Branch of National Council of Teachers of Mathematics (Past Chairman, Recorder, Delegate Assembly). Listed in *American Men of Science*, *Who's Who in American Education*, and *Who Knows and What*.

Activities in NCTM: Louisiana-Mississippi State Representative; Member of Planning Commission of 1952 Symposium on Teacher Education in Mathematics; Co-editor of the Department, "What Is Going on in Your School?" of THE MATHEMATICS TEACHER; Recording Secretary of the Board; served on several committees of NCTM and MAA.

Other Activities: Director of the Louisiana State University Mathematics Institute; Chairman, Standing Committee of Mathematicians of Louisiana for the Furtherance of Mathematical Education; Past Secretary and Past Chairman of the Mathematics Section of the Louisiana College Conference; Past Secretary of the Louisiana College Conference; Past President of the Louisiana State University Faculty Club; Past International President of Lambda Chi Alpha Fraternity; Secretary of National Inter-fraternity Conference; read many papers before annual NCTM meetings.

Publications: "Preparation of Teachers of Secondary Mathematics" and "Junior College Mathematics Curriculum Problems in View of the President's Report," THE MATHEMATICS TEACHER; "Legislation vs. Education," *American Mathematical Monthly*.

Philip Peak
Central Region

Assistant Dean, School of Education and Head of the Mathematics Department, University School, Indiana University, Bloomington, Indiana.

B.A., Iowa State Teachers College, Cedar Falls, Iowa; M.S., University of Iowa; Ph.D., Indiana University.

High school mathematics teacher, Mechanicsville, Iowa; Head of Mathematics Department, high school, Pierre, South Dakota; Assistant Professor of Mathematics and Critic Teacher, Chadron State Teachers College, Chadron, Nebraska; Head of Mathematics Department, University School, Indiana University, 1942– ; Assistant to the Dean, School of Education, Indiana University, 1950–55; Assistant Dean, School of Education, Indiana University, 1955– .

Member: NCTM; CASMT (President, 1951–52); AAUP; NEA; Indiana State Teachers Association (Past Chairman, Mathematics Section); Phi Delta Kappa (Past Treasurer of Alpha Chapter).

Activities in NCTM: Indiana State Representative; Member of Twenty-Second Yearbook Committee; Chairman of Research in Algebra Committee; Secretary for the Madison, Wisconsin Mathematics Symposium, 1952; Associate Editor, THE MATHEMATICS TEACHER, and author of monthly column in that publication, "Have You Read?"

Publications: articles on the teaching of mathematics in THE MATHEMATICS TEACHER, *School Science and Mathematics*, and *Phi Delta Kappan*.

H. Vernon Price
North Central Region

Professor of Mathematics, State University of Iowa and Head of Mathematics

in University High School, Iowa City, Iowa.

B.A., State University of Iowa; M.S., Northwestern University; Ph.D., State University of Iowa.

Teacher of Mathematics, Thornton Fractional Township High School, Calumet City, Illinois, 1931–34; Teacher of Mathematics, University High School, Iowa City, Iowa, 1934– (Head of Department and Supervisor of Teacher Training since 1940); Department of Mathematics, State University of Iowa, 1940– ; Supervisor of ASTP, Basic Phase, army training program in mathematics at the State University of Iowa, 1942–43; Visiting Professor, School of Education, University of Michigan, summer, 1952; Visiting Professor, Department of Mathematics, University of California at Los Angeles, summer, 1955.

Member: NCTM; Mathematical Association of America; Central Association of Science and Mathematics Teachers (President 1954, Board of Directors, various committees); Iowa Association of Mathematics Teachers (various offices); Chairman of State Curriculum Revision Committee in Mathematics; Phi Beta Kappa; Sigma Xi; Phi Delta Kappa. Listed in *American Men of Science.*

Activities in NCTM: Member, Commission on Post-War Plans, 1945–47; Chairman, Banquet Committee, 30th Annual Convention, 1952; Secretary of Symposium on Teacher Education in Mathematics, University of Wisconsin, 1952; Member, Committee on Publications of Current Interest; Member, Committee on Revision of the Guidance Pamphlet; Vice-President, Senior High School Level, 1954–56.

Publications: Co-author of *Basic Skills in Mathematics;* "Mathematics Clubs" and "The Small High School," in THE MATHEMATICS TEACHER; "We *Can* Remove the Stigma from General Mathematics" and "An Experiment in Fusing Plane and Solid Geometry," *School Science and Mathematics;* author of a variety of examinations for Iowa and Missouri state-wide testing programs, Adjutant General's Office, and Cooperative Test Service.

Annie John Williams

Southeastern Region

Teacher of Mathematics, Durham High School, Durham, North Carolina.

A.B., Greensboro College; M.A., University of North Carolina; additional graduate study at North Carolina State College and Duke University; attended Mathematics Institutes of Duke University (1944, 1946–52), New England (1952), and University of Virginia (1953–54).

Teacher of Mathematics, Blackstone College, Blackstone, Virginia, 1934–35; Hoke High School, Raeford, North Carolina, 1935–37; Massey Hill High School, Fayetteville, North Carolina, 1937–42; Alexander Graham Junior High School, Fayetteville, North Carolina, 1942–43; Julian S. Carr Junior High School, Durham, North Carolina, 1943–53; Durham High School, Durham, North Carolina, 1953– .

Member: NCTM; NEA; Mathematics Association of America; Central Association of Science and Mathematics Teachers; North Carolina Education Association (President, Department of Mathematics, North Central District, 1949–50; State President, Department of Mathematics, 1954–55; Chairman, Program Committee, Mathematics Conference, University of North Carolina, 1954–55); Durham City Education Association (Treasurer, 1945–46); AAUW (Vice-President, Local Branch, 1946–48); Steward, Duke Memorial Methodist Church; Delta Kappa Gamma.

Activities in NCTM: North Carolina State Representative, 1947–54; Delegate to Delegate Assembly, 1953, 1955; Member, Agenda Planning Committee for the Seventh Delegate Assembly; appearance on convention programs.